METAL INDUSTRY

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Industrial Design

WITH the coming of the Industrial Revolution, mechanics and utility reigned supreme over beauty, and even up to recent times excellence of line played little part in engineering production. But, as the Rt. Hon. Lord Mills emphasized in opening a recent conference on "Industrial Design and the Engineering Industries," organized by the Council of Industrial Design in collaboration with the Birmingham Engineering Centre, though in a seller's market it may have been possible to ignore the niceties of good design, it seems hardly likely that firms which rely on outdated designs can maintain their trade in a really competitive market, particularly overseas.

When the Council of Industrial Design was set up in 1944 as a grant-aided body under the Board of Trade, its terms of reference were "to promote by all practicable means the improvement of design in the products of British industry." Until recently, almost all the energies and funds of the Council have been absorbed by its work in the consumer goods industries. No one can deny the impressive change that has taken place in these industries as a direct result of this work, and although this task is by no means completed, it is now intended to concentrate on the engineering industries. Hence the organization of a conference to discuss the methods by which the new techniques of design can best be applied in that field.

Appearance design of power presses formed the subject of one Paper at the conference. In it, Mr. Louis Schuler pointed out that in the past the narrow limitations set to the designer by the constructional methods available meant that little attention could be paid to the external appearance of presses. With the adoption of welded box frame construction and improvements in casting methods, the designer has far greater possibilities in obtaining a pleasing external line. High-power driving gear of relatively small size can now be housed within the machine without adversely affecting the general outline. Well-designed controls eliminate mistakes in operation from the start, there is less danger of accidents caused by external linkages, and maintenance is simplified. It is obvious that technical considerations must come first in the design of any machine tool; there is no place for a machine tool on which it is difficult to carry out maintenance work due to an excess of zeal on the part of the appearance designer. But, when machines are equal from the technical point of view, the machine of better appearance is preferred even if the cost is higher.

Dealing with the role of the industrial designer, Mr. Misha Black said that the specialized function of the industrial designer had long been accepted in the craft-based industries such as textile and pottery manufacture, but it is only since the late 1920's that more than a handful of manufacturers have conceded that industrial design can, and should be, a specialized activity in the light and heavy engineering industries. He suggested that the future of design development depends on the employment of trained and qualified staff designers, with the consultant designer also playing an important part.

The slogan of the Council of Industrial Design is "Good design is good business," and in the consumer goods field it has proved to be true. There is every reason to believe that the same would hold for all industries. It is to be hoped, therefore, that this conference will be the forerunner of many others on the same subject, for, in the words of Lord Mills, "We can point with pride to an enormous range of products where the percentage of brains and skill involved in their invention and manufacture is extremely high. The greater this percentage, the greater the gain to the national economy. If we add to this the art to ensure that their appearance conveys their excellence to both buyer and operative, we shall be contributing in no small measure to the national good."

Out of the
MELTING POT

Please Supply SUPPLIERS of scientific instruments on the look-out for new lines should spare a thought to the possibility of developing a simple and versatile instrument capable of detecting and measuring the emission of "exothermic" electrons. These exothermic electrons, or exoelectrons, are emitted from surfaces of solids after the latter have been subjected to various treatments. Thus, in the case of metals, electron emission follows upon elastic or plastic deformation, machining, abrasion of the surface by various means, and upon the formation of new surfaces by comminution of the metal. It was originally believed that the emission of these electrons from such surfaces was connected with the occurrence of some exothermal processes; hence the name exoelectrons. The present view is that these electrons originate in thin non-metallic surface films, e.g. oxide films, by a mechanism related to that responsible for luminescence phenomena. Emission, stimulated in one of the ways mentioned above, diminishes gradually with time and finally disappears. At that stage a further emission can be stimulated by heating, exposure of the surface to light, ultra-violet, X-rays, etc. The detection and recording of exoelectrons by means of various types of counters, or with some form of electron multiplier, is rendered difficult by their low energy of only a few electron volts and their consequently very low penetrating power. This is where the instrument makers could help. Once a suitable instrument was available, exoelectrons would be ready to change from a laboratory curiosity to a phenomenon of promising usefulness in laboratory investigations and, later, for production control purposes. Uses of the phenomenon can be envisaged in connection with stress distribution studies, fatigue tests (there is evidence of exoelectron emission being able to show up "damaging" and the region from which a fatigue crack will ultimately start), in connection with surface finishing, the production of metal powders by grinding, the investigation of pressing, sintering, etc. The demand for a suitable instrument would certainly be there.

Magnetic Writing IN these days of electronics, familiar terms, like brain, memory, writing and reading, have been acquiring new meanings. Writing, for example, no longer implies the process of placing a more or less legible record on paper with the aid of pen or pencil. Writing can be done magnetically, using a magnetic field in order to effect local changes of magnetization which constitute the "writing" on a magnetic tape or film. If a premagnetized film is employed, a magnetic field need no longer be used for recording. Instead, the information can be inscribed by locally heating the film above the Curie point. In a film which has been premagnetized to saturation normal to its surface, demagnetization of portions of the film by heating above the Curie point will be followed by remagnetization of these areas in the opposite direction on cooling. Originally, this method of Curie-point writing made use of a heated point or stylus which was moved over the surface of the magnetized film to trace the desired pattern. A recent development of this method makes use of a focused electron beam as the source of heat. Experiments showed that with a sufficiently intense beam, traces could be written in a single sweep, the width of the trace diminishing with increasing velocity of writing until the velocity becomes too high to give sufficient time for the film to become heated beyond the Curie point. A writing speed of 3×10^4 bits/sec. was obtained. This could be increased to 10^5-10^6 bits/sec. by using a more intense beam, preheating the film to near the Curie point, and by reducing the heat capacity and dissipation of the substrate of the magnetic film. An information density of 10^5 bits/cm^2 has been obtained. An increase beyond this figure would depend on the availability of finer grained films. Magnetic writing of this kind can be read by making use of the magneto-optic effect or electron mirror microscopy. The metallurgical interest of magnetic writing centres on the films, which consist of the compound MnBi. The films can be obtained by successive vacuum deposition of manganese and bismuth, followed by interdiffusion. The MnBi has a Curie point of 350°C. The films obtained in this way are quite resistant to atmospheric moisture, whereas MnBi powder and permanent magnets produced from it corrode rapidly in high-humidity atmospheres.

Doubtful PROBABLY the most significant aspect of the growing interest in the whole subject of management is the uncertainty as to whether it is, or can be made, a science. There is certainly no doubt about the efforts being made towards making management into a science, nor about the success that has already been achieved in that direction. The plain question: "Management—art or science?"—must, therefore, already be modified to one enquiring about the possibility of replacing the residuum of the art by science. In this modified form, the question loses much of its original interest and, if pursued, is likely to develop into a largely academic discussion. Indeed, the significance of the question in its original form does not lie in the eventual answer. It is to be sought, rather, in the reasons that have prompted its asking. Quite clearly, the main reason is the doubt as to the desirability of it becoming firmly established that management is really a science, or of management, such as it used to be, or even such as it is at present, being successfully turned into a science. Why should there be this doubt? There is, after all, the recent evidence to the effect that scientific management techniques as taught at the numerous courses in the subject prove successful when applied in certain circumstances. The volume of such evidence is likely to grow as such suitable circumstances become more widespread. There is the overwhelming evidence of the popularity of these numerous training courses, of the even more numerous books on the subject of management, and of the eagerness with which scientific aids to management, up to and including electronic computers and brains, existing or yet to be developed, are being welcomed. All this leaves no doubt that in management, as in so many other fields, science is being called in to build up an imposing and, if possible, impenetrable functional facade behind which the art, such as it is, of management can hide. However apparently successful all this may be, it may or may not be advisable. Hence the doubt that prompts the questions.

Skimmer

MANAGEMENT SCIENCE AND ITS RELEVANCE FOR SCIENTISTS

Metallurgists and Managers

By H. W. G. HIGNETT, B.Sc., F.R.I.C., F.I.M.

Discussing the problems and factors affecting relations between management and scientific employees, and suggesting some of those which require particular attention, this article is based on the Chairman's Address to the Birmingham Local Section of The Institute of Metals.

FOR the purpose of this article, the title "metallurgist" is to include anybody who practises any of the accepted branches of metallurgy — extraction or physical, control or research. A "manager" is taken to be somebody who directs the practice of somebody else. Under the present title, the relationship between metallurgist and manager may thus be discussed; the problems of metallurgists with regard to the system of management by which their activities are controlled, and their aspirations are, perhaps, limited. On the other side of the picture, the task of management in making the best use of metallurgical talent and technique may be considered. As a metallurgist, the writer speaks with the authority of at least considerable and varied experience. On the contrary, his views on management are those of an inexperienced but earnest student whose enthusiasm frequently overcomes his diffidence.

The first duty of a metallurgist is clearly to earn a living, and presumably he or she chooses a metallurgical career in the hope that it will be intellectually as well as materially satisfying. In selecting his first employer the young metallurgist would have been prudent to consider the following questions, and wise above average to place them in this order of importance:

(1) Shall I respect my boss?
(2) How shall I grow in the job, personally and professionally?
(3) Will the job grow fast enough?
(4) Shall I like my colleagues?

From the other side of the desk, the interviewer should ask:—

(1) Shall we like him?
(2) How wide are his interests?
(3) Is he intellectually honest?
(4) Has he plenty of curiosity?
(5) Can he express himself clearly?
(6) Has he had a sound training?

At this stage of his career the candidate need pay little heed to two questions which will later become important: interest in salary should be small by comparison with concern for a start which will lead to a satisfying position, and concern for security should be negligible. The employer, too, can leave two further questions for later consideration, namely:—

(7) What capacity for development has he?
(8) Will he remain pre-eminently a scientist or technologist, or will he turn into a good manager?

Even before this stage the employer must have asked the question "Can we afford to appoint another metallurgist?" It is not always realized how difficult it can be to tackle this question precisely and definitely, and how often the answer contains a substantial element of faith. The working of any industrial concern is carried on by three different types of people—(1) managers; (2) professional employees such as metallurgists; (3) other workers —clerical and manual.

The last of these provide the "direct labour cost," which can be allocated correctly to specific items or groups of items of production. The cost of the managers and professional employees must be spread over a considerable volume of output as overheads, the allocation of which presents problems more complex than those of metal physics. In the case of straightforward quantity production of standardized articles, it is probable that overhead costs can be allocated with reasonable accuracy. In any more complex type of business, however, arbitrary systems of gross approximations must be adopted, and there is little hope of improving upon these until much more experience has been obtained in the application of electronic computers to costing. Clearly, therefore, there is no expeditious means of determining the economic result of appointing an extra metallurgist to the staff.

Let us consider for a moment the economic aspect of a research department. The total expenditure it involves per week, per month, or per year, can be determined precisely, but the costing of its individual operations is much less easily accomplished. Many schemes have been devised, and some are still in use, in which research workers are involved in attempts to report accurately the allocation of their time to individual investigations. In a very large research organization, where investigators can be grouped into organized teams working on clearly-defined projects, it is, perhaps, practicable to obtain a reasonable estimate of the cost of these projects. In a smaller organization such estimates are scarcely practicable and of very doubtful value.

Detailed costing in a factory producing a variety of articles has two main objectives. The first is to determine the cost of each unit of production with sufficient accuracy to ensure that its selling price affords an adequate profit. The second aim is to arrive at the cost of each operation involved in producing the finished article, in order to determine whether inefficient technique exists and where saving can be effected. One may recall, for example, cases of modifications to casting technique which, although reducing the cost of the casting, have involved an increase in machining costs far outweighing the saving effected. Conversely, there are occasions when it can be profitable to increase the cost of a casting in order to reduce the cost of the finished article.

It may thus be seen that neither of the two objectives is obtainable in a research department. The first is lost because nobody can assess the selling price of a research result; the second is reduced to absurdity when one considers an approach to a simple research programme based on the estimated costs of the individual experiments involved in it.

Now let us reflect upon the problem of calculating the value of an extra metallurgist on a production staff engaged on quality control, trouble-shooting, process development, and like duties. How does one measure the worth of his negative results? How can one evaluate the trouble that would have occurred if he had not been able to prevent it?

For the moment it must be assumed that the extra metallurgist has been recruited for reasons which seem good and proper to the management, and examination of what is expressed by the term "management" may perhaps go some way towards explaining the reasons. At the same time, it may also explain why the term "scientific management" is somewhat unfortunate.

Before the end of the eighteenth century, Matthew Robinson Boulton and James Watt, Junr., applied, in the Soho Foundry, management techniques which even to-day are regarded as commonplace only in the most progressive concerns. Their costing system has not been improved upon save by the introduction of equipment which was not available to them; and while certain individual aspects of their methods were not original, these two men were certainly the world's pioneers in the collective use of market research, production planning, process standards, comprehensive statistical records, training schemes for both workers and staff, payment-by-results based on work study, and a welfare system including sickness benefits.

On the tomb of Frederick Winslow Taylor, of Philadelphia, U.S.A., is inscribed "The Father of Scientific Management." The passionate zeal and dispassionate integrity of this man would have made him a notable figure in any branch of human endeavour. In industrial history, his stature is outstanding and has not diminished with the passing of time, even though he has often been blamed for the evil results of misapplying some of the techniques of which he was a pioneer. In the field of work measurement and method study, Taylor laid foundations which support the most valuable aid to productivity that is available to industry. The importance of this aid is so vital to the economy of this country and, perhaps, indeed, to its survival, that the question is not so much whether work study ought to find a place in metallurgical curricula, but whether its principles should not be taught at school.

Most metallurgists are quite accustomed to the idea of development following research. To the industrial metallurgist it must become equally ineluctable that work study should follow development.

Work study comprises two main techniques:—

(1) *Methods Study*—The detailed analysis of existing or proposed methods, with particular reference to the use made of material, machines and manpower, with the objectives of improving layout and design, providing a better working environment, and disclosing profitable avenues for further research and development.

(2) *Work Measurement*—The determination of the appropriate time to be allowed for the effectual performance of a specified task, with the following objectives: more economic and effective manning, improved production planning and control, reliable performance indices, a rational basis for incentive schemes, and dependable means of labour cost control.

By themselves these techniques can achieve nothing; they are, however, a powerful tool of management, and their practical value depends on the intelligence and skill with which they are used.

The objective of work study is not solely to provide a basis for incentive payment schemes; indeed, these do not even constitute a primary objective. The main conclusions of an impressive and valuable review by Marriott[1] are relevant and may be summarized in two quotations:—

"The continuing widespread use of payment-by-results (schemes) as a means of increasing productivity suggests that they are still considered to be more advantageous than otherwise. Unfortunately, they have often received the credit which was due to simultaneous improvement in other directions."

". . . however potentially effective a financial incentive may be, it cannot reach its maximum effectiveness and, in fact, will often fail unless installed and maintained in the most encouraging circumstances."

Since the essential task of industry, whether it be nationalized or not, is to operate at a profit, the primary function of management is economic. As we have seen, the efficient deployment of labour made possible by applying work study and work measurement techniques, the encouragement of effort by incentive payment schemes, and the roads to technical efficiency which are illumined by the cost accountant, are all aspects of the manager's job. Another of his duties, which has been touched upon, is the recruiting of staff, and accompanying this task is the responsibility for making sure that as many as possible of the "pegs" fit reasonably well into their "holes."

Efficiency of staff must be looked upon from three directions:—

(i) The efficiency of the individual in the job for which he is well fitted.

(ii) The efficiency of individuals doing jobs for which they are not particularly well fitted.

(iii) The collective efficiency of the group.

This last is evidently governed by the "goodness of fit" of people to jobs, and by the degree of success achieved in encouraging the people to give of their best. It should be emphasized that obtaining an accurate fit between people and jobs is rarely a single-stage operation. Something like the procedure of a good tailor must be adopted—careful measurements preparatory to a number of "fittings," followed by appropriate adjustments. It is to be noted that the adjustments are made more readily to the garment than to the person—and it is wise to remember that whittling a peg always makes it smaller.

It should now be possible to see more clearly the distinction between manager and metallurgist. While the former is responsible for the work of others, it behoves the latter, whether working by himself or as a member of a team, to concentrate upon his own contribution, and in relation to this alone can he measure the success of his efforts. He can be doing a good job while his company is heading for liquidation, since his yardstick is graduated in a scale of professional standards.

The manager may also have professional standards, but they alone do not set his target, which is constituted by the objectives of his company—among which, as already indicated, is to make best use of professional staff (in our case, especially of metallurgists).

Many professional men, particularly those engaged in research, have scant respect for the administrator, and are unable to develop genuine interest in his work. It is useless to promote such people into administrative posts; indeed, the better they are as scientists the more futile it is to try to transform them into managers. It is clearly necessary, therefore, to ensure that the needs of the "professional" metallurgist are satisfied by motivation, participation, personal satisfaction, financial reward, and status. He must not merely have opportunity to make an individual contribution to the work of the concern, he must be aware of its significance to his colleagues, even though, and, indeed, especially when, this differs considerably from its significance to himself. He must have opportunities for promotion on a professional as distinct from an administration ladder, leading to senior posts of adequate status and prestige. Last, but not least, he needs to have his accomplishments recognized in a different way from those of his non-professional colleagues. If he is a good metallurgist he will be at least as pleased by knowledgeable praise for an elegant piece of investigation as by enthusiastic congratulation on improved yields and consequent reduction in cost. The single-minded scientist who cannot keep his own personal finances in an interpretable condition must not be expected to steer his efforts along a course which is charted by financial considerations. He must be guided along such a course by colleagues who can measure the value of his work both in technical and also in economic units. That is why non-technical managers are at a disadvantage in a technical business and, therefore, why more metallurgists must be encouraged to turn into managers.

Professional recognition outside the organization is also of considerable value to the ambitious metallurgist, but, in industry at any rate, it can never be an adequate substitute for the high regard of professional colleagues with the organization. There is no more pathetic figure than the metallurgical prophet whose honour on committees and in extra-mural activities far excels that "in his own country."

The pattern of responsibility of "professional," "specialist," "advisory" or "functional" staff on the one hand, and "executive" or "operational" staff on the other, constitutes the "organization structure" of a concern. This is an enormous subject in itself, and it is possible here to do no more than touch upon three points for consideration.

In the first place, there is the interesting question of the span of supervisory responsibility. The number of subordinates which an executive can adequately take care of is quite large if his relationship with them is simple and direct, but if there are inter-relationships between the subordinates, singly or in groups, the situation becomes much more complicated, and a simple arithmetical approach suggests that the maximum number of subordinates having closely inter-related responsibilities should be five or six. Such figures agree fairly well with the conclusions reached as a

result of the practical experience of several distinguished authorities.

Secondly, it should be emphasized that if a senior executive accepts the principle that the scope of responsibility of his subordinates should be clearly defined, he automatically restricts his own freedom of action. It is, therefore, much easier to try to get "the best of both worlds" by deputing responsibility on a vague day-to-day basis, but this usually leads to misunderstandings. An orderly organization requires the strictest self-discipline on the part of its senior ranks in order that authority be matched by responsibility at lower levels.

Thirdly, it must always be remembered that, however logical its plan, an organization will fail unless it possesses something more than can be described on a chart or illustrated by a model. This "something" is implicit in the terms "team spirit," "esprit de corps," "group morale," "company prestige," and is composed of the personal satisfaction that individuals gain from being associated with enterprises of a character which command their energies and loyalties to be given unhesitatingly.

It is, perhaps, not generally recognized that there is a clear distinction to be drawn between "management" and "leadership," although the latter is undoubtedly an important constituent of good management. Some people may be born leaders, but most have leadership thrust upon them, while many unfortunates find too late in life that they do not possess the innate characteristics to enable them to be good leaders. The leadership which is embraced in management should, as much as possible, be by suggestion. While in other fields of endeavour, and particularly, of course, in the military field, leadership requires the giving of orders, good management, on the contrary, is the art of avoiding the need to give orders.

In recent years the problems of management succession, which call for a great deal of understanding and foresight, have been receiving the close and detailed attention that they fully warrant, and has been so sadly lacking in the past. To a large extent the deliberate selection of young men for training in management is likely to go a long way towards providing the answer to this difficult problem in the future. Nevertheless, it cannot be too strongly urged upon young metallurgists and, indeed, upon all young technologists, to profit by the day-to-day opportunities available to them from the very outset of their careers, to determine for themselves whether they are fitted by nature to tackle the problems of management, or whether they would be better advised to concentrate their efforts on other work of a rewarding nature in which a different type of problem is to be faced. Such opportunities are provided to the young metallurgist, for example, by observing the way in which his own superior deals with him and, later, in his own handling of his first assistant, who can help him to learn easily many important principles of management which later become difficult to master. It is unfortunate that many of us do not realize this until too late.

The field of management practices and principles is covered by a literature as voluminous as that embracing the whole of metallurgy. In this short article, which owes much to the writings of several distinguished authorities, it has been possible merely to point to limited areas of the whole field. The largest and most important area, concerned with problems of human relations, has not even been outlined, since it would be impossible, within the compass of a few pages, to summarize the millions of words which have been written on the subject in recent times—and, after all, the solution to all these problems was so clearly given about two thousand years ago.

Finally, the writer gladly takes opportunity to express gratitude to all the colleagues under and with whom he has worked, from whom he has profited so much, and to whom no responsibility can be attached for this interpretation of some of their teachings.

Reference

1 R. Marriott; "Incentive Payment Systems—A Review of Research and Opinion," pp. 191, 205, 1957. Staples.

Filter Cloths for Titanium Sponge

FILTER cloths made of the synthetic textile fibre, Dynel, have effected improved efficiency and reductions in cost and time in the production of titanium sponge at the Electro Metallurgical Company, Ashtabula, Ohio, one of the largest titanium sponge plants in the United States.

The filter cloth is employed to hold titanium sponge while it is being spun dry in the centrifuge at speeds up to 500 r.p.m. for 20 min. It is capable of enduring 600 process cycles before requiring replacement. This, as compared to the 24-cycle service life of material previously used, represents an overall saving of about 90 per cent.

Wet strength and resistance to chemicals are the inherent properties of the fibre that result in added service life. When first placed in the centrifuge, the titanium sponge is heavily laden with harsh acids. It is washed thoroughly several times before being spun dry. The synthetic fibre cloth does not deteriorate from exposure to the chemicals, and retains its strength and shape after the repeated wetting and drying processes.

Another advantage cited for the synthetic material over other filter cloths is that it retains an open weave to permit free escape of moisture at all times, eliminating the problem of costly shut-downs due to plugging or blinding of the fabric. The woven Dynel cloths measure 26 in. wide by 18 ft. long, to fit against the circular wire wall of the centrifuge.

Prior to centrifuging, a mixture of titanium sponge and salt is charged into a leach tank over the centrifuge containing water acidified with hydrochloric acid. Following the leaching operation, the slurry of brine and titanium sponge is charged into the centrifuge, where the brine is separated from the sponge. When about 5 in. of sponge has been built up in the centrifuge basket, the charging operation is interrupted while the sponge is washed, spun dry, and finally scraped from the filter cloth by means of a hydraulically operated blade. The charging cycle is then resumed. The sponge removed from the centrifuge is subsequently vacuum dried, blended, packed, and shipped to melters and fabricators of metals.

Aluminium Weld Defects

IDENTIFICATION of those defects in aluminium fusion welds which can be seen in radiographs is made easier by a booklet published by the British Welding Research Association, 29 Park Crescent, London, W.1. The defects are classified, their origin explained, and suggestions for their prevention are made.

The book recognizes five groups of defects: (1) Cracks. (2) Lack of fusion, including incomplete root penetration. (3) Voids, including the three types of porosity, uniform, localized and linear, as well as elongated cavities and crater pipes. (4) Inclusions of oxide, flux or metal, the latter usually tungsten but sometimes copper or iron. (5) Imperfect shape, including defects which may, or may not, be seen on visual inspection, depending on the joint design, such as undercut, excessive penetration, and root shrinkage.

Surface marks give characteristic shadows in radiographs, and they are, therefore, included, though they are not defects.

The book, H3/58, entitled "Classified Radiographs for Defects in Aluminium Fusion Welds," is free to members until February 1, 1959; the cost to non-members is 10s.

Products and Processes

TRENDS IN THE DEVELOPMENT, APPLICATION, PROCESSING, DESIGN AND WORKING OF NON-FERROUS METALS AND THEIR PRODUCTS

Electrolytic Process Produces Zinc Foil

A PILOT plant unit for the continuous production of zinc as a thin foil is in operation at the Central Research Laboratory of American Smelting and Refining Company. Sheets ranging from 0·005 to 0·001 in. in thickness and 26 in. in width constitute the present output.

In the new method, zinc is deposited electrolytically from a zinc sulphate bath on to a revolving drum. The foil is stripped from the drum in a continuous sheet of uniform thickness. This electrolytic process is said to be more economical than the older, conventional metal rolling techniques, and to produce foil of high chemical purity and with unique ductility and tensile strength.

It is believed that the foil may have certain applications in the electrical industry. As a moisture barrier in insulating compositions, the zinc foil has the advantage of adhering to bitumastic materials better than most metallic foils.

Unlike some other metallic foils, zinc foil can be easily soldered, and can be printed on.

Simplifying Heating Coil Assembly

PRIMARILY intended for heating coils in tankers, a new pipe clip offers advantages in virtually any application where rapid and inexpensive clipping is required. It is being produced by Charlton, Weddle and Co. Ltd.

The new clip dispenses with nuts and bolts, and no marking-off or drilling of holes for the clips is necessary. If silver-soldering of joints is needed, the clips hold the heating coils firmly for the operation.

The clip assembly can be made from any metal and is, therefore, of interest to most branches of industry where pipework is used. The clip is being produced to fit bearer bars 1½ in. wide. It can be secured in place in approximately 1 min., and once fixed it is immovable except by a special tool.

Aluminium brass strip is being used for clips which are for installation with aluminium brass heating coils. Clips of aluminium alloy are being provided for heating coils made of the same metal to prevent bi-metallic corrosion. Insulation of the clip assembly from the steel bearer bar is achieved by laminating sheet "Fluon" to the base of the rubbing piece. The dimensions of the "Fluon" insulating pad are such that when the clip is fixed in position, the whole of the bearer bar in way of the clip is completely shielded on the top and undersides. To provide a leak-off for static electricity, a number of the "Fluon" pads are carbon-filled to give known resistance value.

A special compression clamping tool has been designed for the job of fitting the clips. Worked on a pincers principle, the tool compresses the clamps holding the clip to the bearer bar. Two simple movements at each clip are all that is required.

Ceramic Coatings on Metals and Other Materials

MANY of the limitations which confront the manufacturer and designer of conventional, solid ceramic parts may be overcome by the application of ceramic coatings to steel, brass, copper, aluminium, etc., glass, and even plastics, and a method has been developed by the United Insulator Division of The Telegraph Condenser Co. Ltd. in which the ceramic material is specially prepared, then heated to a temperature in excess of 3,000°F. and applied at high pressure to the part to be coated, which is kept cool.

The thickness of the coating can be made just a few thousandths of an inch or built up to 10 mm., 20 mm. or more.

Materials already adopted for coatings include "Unilator," a gem-hard ceramic which can be made electrically insulating or conductive, as required; "Unilatum," a high-temperature, high-insulation ceramic, also of gem-hardness, and "Unilain," a heat and electrical insulator.

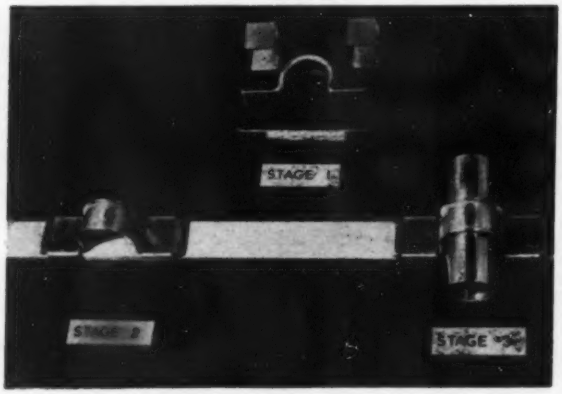
Applications for these coatings can be divided into four main groups: (1) Protection from abrasive wear. (2) Electrical insulation. (3) Heat insulation. (4) Special use of dielectric properties. A combination of these is also possible. Specific examples include:—bearings, mechanical seals, pump impellers, cam surfaces, and, for the textile industry particularly, thread guides and machine parts which are subjected to the very severe wearing action of modern man-made fibres.

Where heat-resistance is important, as in thermocouple sheaths, hoppers, heater supports, crucible and ladle linings, jet and rocket motor exhausts and parts, etc., the ceramic coated metal is especially valuable, and other applications include heater formers, R.F. induction heating coils, miniature components, dielectric heating tables, resistor and coil formers, etc.

Titanium Solder

GOOD results have been obtained in the soldering of titanium with a solder alloy comprising up to 85 per cent of silver, the balance consisting of either aluminium alone or mainly aluminium with small proportions of one

Components of the boltless pipe clip. The two clamps, the clip and rubbing piece are shown at the top. At the bottom the clip is shown in position on a bearer bar (left) with the clamps loose, and at the bottom (right) the clip is holding a section of heating coil



The fitting tool used with the boltless clip. The tool, as can be seen, works on a pincers principle and ensures absolute firmness

or more of the strengthening elements—titanium, nickel, copper, manganese or silicon.

The solders are in the form of a binary alloy consisting of approximately 30 per cent silver and 70 per cent aluminium, or ternary alloys in which the binary alloy is modified by adding up to 2 per cent of nickel or 2 per cent of manganese, or 1 per cent of silicon, or 3 per cent of copper, or 10 per cent of titanium, at the expense of reduction in the aluminium content. These solders, which are covered by a patent application, originated from the Ministry of Supply R.A.E., and the work is described in *N.R.D.C. Bulletin.*

In melting the alloy, each strengthening element is added in the usual way as a constituent of a so-called "temper metal" alloy with either silver or aluminium, which is rich in the element. The billet is first rolled at a temperature of about 500°C. after annealing, and is subsequently annealed as required during rolling, which may be continued until it is reduced to about 0·010 in. in thickness. In general, the solder is best prepared as a foil, since in this form it can be most easily used in a controlled atmosphere or in the vacuum soldering process usually employed in soldering titanium and its alloys.

Those solders containing nickel and manganese have the special advantage of relatively high ductility, so that a failure in a soldered joint tends to be localized and not to lead to complete failure of a joint. In general, the new solders have good wetting and flow properties, which enables joints of consistent quality to be made, and the joints themselves, which include inter-metallic compounds, are relatively ductile because of the presence of the silver.

Unloading Large Presses

FOR handling large sheets and pressings, an Iron Hand which eliminates the difficulties and dangers involved in manually feeding presses, forging hammers, shears, etc., has been introduced to this country by a recently-formed company, Sahlin Engineering Company Ltd. The four types available include a large, medium and small size machine of the overhead arm type, and a floor type, horizontal machine, roll-away and fixed base mounting, for small to large stampings.

The Iron Hand may be applied with equal effectiveness to almost any type of metal working, including presses, brakes, shears, forging machines, and die-casting machinery. Speed of operation varies from over 40 strokes/min. with the 100 series to about 20 strokes/min. unloading large parts with the 1,500 series. Being an overhead arm, it requires no floor space, and need not be removed for changing or working on dies. Changeover adjustments from one stamping to another rarely exceed 10 min. and can be effected from floor level. An electronic remote control system is available.

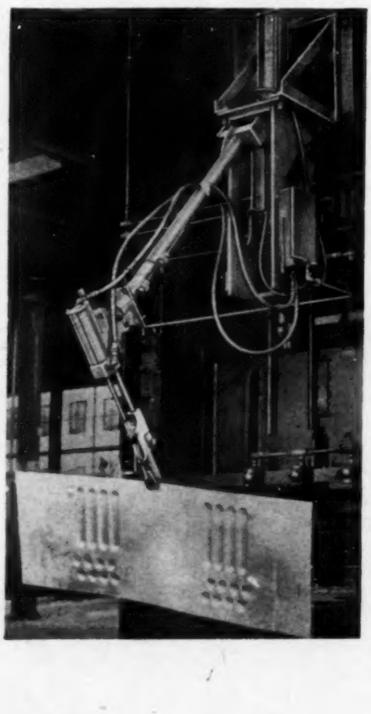
Increased Speeds in Pipe Welding

EFFICIENCY in pipe production is exemplified by a production line, utilizing mechanized Heliarc welding, which produces 1,500 ft. of welded aluminium irrigation piping an hour. The machine forms, welds and cuts the pipe in one continuous production line. The pipe-mill equipment handles 4 in., 6 in. and 8 in. diameter pipe of various metals—Heliarc welded at a speed of 300 in/min.

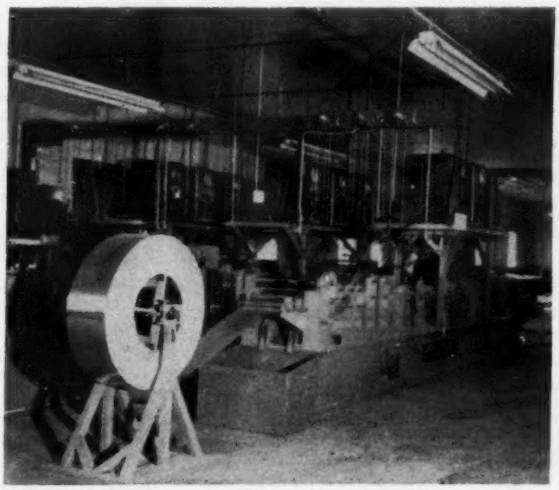
A roll of 0·051 in. thick aluminium sheet is fed into the machine. As the edges are power-brushed, rollers form the sheet into an 8 in. diameter cylinder. The edges are held closed by rollers as the pipe passes under the Heliarc water-cooled HW-13 torch, and is fusion welded. Three power units are stationed above the machinery.

Positioned a short distance in front of the Heliarc torch, a 5 ft. long stationary piece—inserted through still-open pipe—supports rollers which cold work the weld for added strength. Post-weld finishing is done continuously to provide a smooth weld.

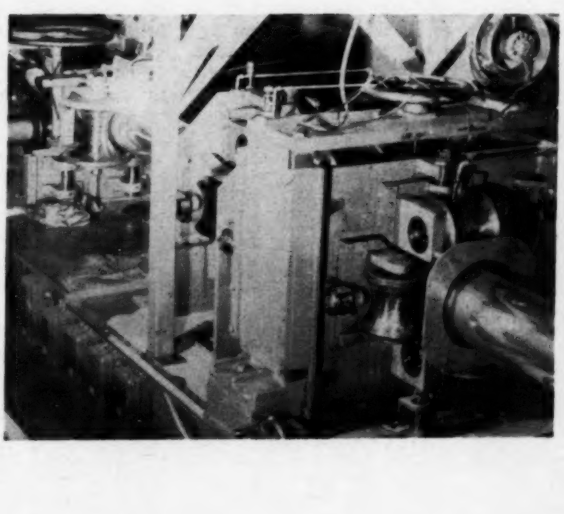
As the final step in the operation, a mechanical cutting device, mounted on a carriage and moving at the same rate as the pipe, automatically cuts the pipe into pre-set lengths.



Left: The Sahlin Iron Hand removing a sheet from a power press



Above right: Start of aluminium pipe production: a roll of 0·051 in. thick aluminium sheet is fed into the machinery where it will be formed into welded irrigation piping



Right: After the edges have been power-brushed, the 8 in. diameter pipe is fusion-welded by the Heliarc HW-13 torch. The side rollers hold the edges closed.

Research Progress

Rammed Sand Properties

BY RECORDER

UNTIL the last few years the preparation of sand moulds has, by tradition and necessity, been the prerogative of experienced foundry hands. Control procedures were rudimentary and the satisfactory behaviour of moulds dependent upon individual judgment. The development of markets for large numbers of replicate castings and the introduction of mechanized handling methods in the foundry have given rise, however, to the need for, and opportunity to practice, greater degrees of control. These techniques depend, though, on an understanding of the influence of moulding variables on those properties of the mould that affect its performance during casting. Since the number of factors involved is large, considerable experimental work has been necessary to establish their relative importance, and is still to some extent incomplete. In addition, general comprehensive surveys of the properties of rammed sands have to be followed by investigations of a more detailed and specialized nature.

Test Conditions

An example of the latter kind of research is described[1] by R. W. Heine, E. H. King and J. S. Schumacher, who measured the hardness, green and dry strength of sands containing various binding agents and controlled moisture, rammed by a number of methods. The hardnesses were obtained with a Dietert tester, the strengths in compression tests. The specimens used were all 2 in. dia × 2 in. high, and were prepared with differing densities by varying the weight of the rammer, the height of drop and the number of blows. Since the cylinders were of constant height, the weight of sand used had to be adjusted according to the density obtained. Presumably, slightly different results would have been given by specimens of constant weight.

A Southern bentonite sand containing 10·2 per cent clay and 4·92 per cent combustibles, e.g. additions of seacoal and cellulose, was tested with moisture contents of 3·8 and 4·3 per cent. The differing ramming techniques gave hardnesses ranging from 64 to 95, the specimen weight, for constant height, varying from 130 to 165 gm. It was found that for a given hardness the green strength was independent of the moisture content and ramming severity. The dry strength was influenced by the water content, however, and at a given hardness level, the dry strength of the sand containing 4·3 per cent moisture was always greater than for 3·8 per cent. The green strengths of samples rammed by the standard 3-blow A.F.S. method, using a 14 lb. weight, were 13·7 and 17·0 lb/in^2 respectively for moisture contents of 4·3 and 3·8 per cent, but these values dropped to only 3·6 and 4·0 lb/in^2 respectively when the ramming was achieved by 5 blows with a 2 lb. weight. Strengths of the latter order are of practical importance, since the properties of a sand at a parting line may be determined by a jolting operation that is equivalent in ramming energy to the low-weight ramming mentioned.

Hardness : Green Strength Ratio

As the hardness and green strength appeared to be related, the authors extended the range of moisture contents to 3·3–4·9 per cent, i.e. to cover likely variations in normal practice. The independence of the hardness: green strength relationship with respect to moisture content was confirmed. A family of curves was thus obtained showing the green *v.* dry compressive strengths at five moisture contents. At a given green strength the dry strength increased progressively with moisture content. It is interesting to note that with different ramming techniques the variation of green strength and dry strength with moisture contents was not identical in each case: the test method used may thus affect the apparent correlation of these variables.

Other Sand Mixes

Similar experiments were carried out on other sand mixes. An 85 A.F.S. 4-screen sand with 3, 6 and 8 per cent Western bentonite and a range of moisture contents covering the possible moulding values gave results that, in general form, followed those previously described. The effect of the variation in quantity of Western bentonite was to change the relationship between mould hardness and green strength. Thus, at a hardness of 75 the green strengths were 4·75, 6·1 and 7·5 lb/in^2 respectively for the 3, 6 and 8 per cent Western bentonite mixes. The dry strengths of the mixtures at a hardness of 75 also depended on the moisture content. For example, in the 3 per cent mix the dry strength increased from 22 to 67 lb/in^2 as the original moisture contents were raised from 2·0 to 3·2 per cent, and for the 8 per cent mix from 13 to 102 lb/in^2 at moistures of 2·7 and 4·3 per cent. At the one hardness, then, a range of dry strengths between 13 and 102 lb/in^2 could be obtained, depending on the clay and moisture contents.

The results described were for an 85 A.F.S. sand, but virtually identical values were given by both 55 and 65 A.F.S. 4-screen silica sands at corresponding clay and moisture levels. When Southern bentonite was used instead of Western bentonite, however, the dry strength at a given clay content, green strength and moisture content was lowered appreciably, despite a close similarity between green strength and hardness in the two sets of sands. The comparison is rather difficult to make as, for no obvious reason, Heine and his colleagues, though using 3, 6 or 8 per cent clay in the two series, did not test the sands at the same moisture contents. Taking cases that can be compared, the order of difference given by the clays may be gauged by results on sand containing 8 per cent clay and 3·8 per cent moisture. At a green strength of 10 lb/in^2, the dry strengths were about 47 and 100 lb/in^2 respectively for the Southern and Western bentonites and at a green strength of 20 lb/in^2 about 85 and 160 lb/in^2 respectively. In both instances, however, the green strengths for a given hardness were increased by raising the clay content, so virtually any given dry strength could be obtained with either clay provided the quantities of bond and moisture were properly adjusted.

In additional work, the 85 A.F.S. sand was bonded with 10 and 15 per cent fireclay. The higher proportions of clay, as compared with the bentonite mixes, were necessary to give green strengths of the same order. Thus, at a particular hardness the 10 per cent fireclay sand could be expected to have the same green strength as a sand containing 4-5 per cent bentonite; 15 per cent fireclay was equivalent in this respect to about 7 per cent bentonite. Higher moisture contents were also required to achieve the higher dry strengths, and at a given green strength the same dry hardness could only be obtained in the fireclay sand if about 1 per cent more moisture was present than in the corresponding bentonite sand, even after making allowance for the effect of the bonding agent. The authors make the point that green strength differences between the types and amounts of clays used tend to diminish at low hardnesses, but in doing so tend to overlook the considerable variations in dry strength that can be attributed to clay type even at low hardness values.

The Paper is concluded by a brief

(*Continued on page 436*)

IMPROVED TECHNIQUES FOR MAKING MELT ADDITIONS

Copper Refining

Application of techniques used in the steel industry is recommended by E. F. Kurzinski in an article in "Journal of Metals," the journal of the American Institute of Mining, Metallurgical, and Petroleum Engineers. This extract contains those features of the techniques which are of particular interest to non-ferrous founders and ingot manufacturers.

MANY materials are added during metal processing to effect chemical reactions or alloying; usually these materials are added in bulk. The additions can be made in the furnace, in the ladle, or in the mould. In the past ten years, a new technique called "fluidjection" has been developed to add more efficiently many materials to molten metals.

In fluidjection, the material to be added to the molten bath is introduced in powder form. The powder is placed in a dispenser, the function of which is to meter the powder material and to mix it with a conveying gas. The powder-conveying gas mixture, now having the properties of a fluid, passes through a refractory tube positioned below the metal surface. The conveying gas can be either inert or chemically active to suit best the requirements of the particular process. Thus, in dephosphorization of steel, which is enhanced by oxidizing conditions, oxygen is the preferred conveying gas. On the other hand, in processes best carried out under reducing conditions, the conveying gas can be methane or propane. Where explosive hazards exist, it is generally preferable to substitute an inert gas, such as nitrogen or argon.

When compared to bulk addition techniques, additions made by fluidjection result in better uniformity, greater recovery, and less segregation in the treated product. If the conveying gas is inert, it provides the additional benefit of flushing dissolved gases from the molten metal, which results in a sounder cast product. Fluidjection also permits the controlled addition of highly explosive materials, such as magnesium powder, which cannot be added safely by the bulk technique.

Fluidjection is used in the steel industry to remove sulphur from hot metal by means of nitrogen-conveyed calcium carbide. The steel industry is also investigating injection of calcium cyanamide for desulphurization of hot metal because of its lower cost and safety considerations.

Leaded steels are made by impinging powdered lead conveyed in an air stream on to the teeming stream. Successful tests have also been made adding powdered ferromanganese into the steel stream during tapping of an open hearth. Flow rates of ferromanganese as high as 1,000 lb/min. have been made, and examination of the cast product showed standard segregation and improved manganese recovery.

In the copper industry, powdered chromium conveyed in an argon stream has been added to copper with 90 per cent chromium recovery. Calcium carbide or calcium cyanamide may prove desirable to desulphurize and deoxidize copper simultaneously. Limited laboratory tests in 100 lb. heats of copper melted under a charcoal cover in induction furnaces have shown that calcium carbide will reduce oxygen content in molten copper from 0·83 to 0·008 per cent. No work has been done with calcium cyanamide for sulphur and oxygen reduction in molten copper.

Inert gases can be used to advantage as stirring agents. The alloying or reaction agent can be added on the surface of the molten copper and, by means of an inert gas introduced below the molten metal surface, better mixing can be attained. In tests in a copper refinery, phosphorus-copper alloy was added to a 550 lb. ladle of copper taken from a billet furnace. One series of billets was made in the conventional manner, adding phosphorus-copper shot followed by mechanical stirring. The second series was made using bulk addition and nitrogen gas stirring. Both ladles of copper were covered with charcoal. The copper was then poured into 3 in. billets. Chemical tests were made throughout the lengths of the billets. Phosphorus content varied from 0·016 to 0·025 per cent for the standard practice dephosphorized copper. Billets obtained when nitrogen stirring was used showed a phosphorus variation of 0·019 to 0·02 per cent.

By nitrogen stirring, improved phosphorus uniformity should be attained in the manufacture of high conductivity phosphorus-deoxidized copper. Thus, it should be possible to add only the specific quantity of phosphorus to provide for the elimination of oxygen. One suggested technique for adding the phosphorus is shown in Fig. 1. Phosphorus-copper shot can be added to the copper in the ladle, and stirred by nitrogen gas injected through a graphite tube fixed in the graphite cover. The nitrogen will thoroughly mix the phosphorus alloy in the copper without incurring atmospheric oxidation or metal splashing.

Another possibility would be to introduce phosphorus vapours below the molten metal surface by means of inert gas streams. Heat from the bath can be used to vaporize the phosphorus alloy.

Investigations have shown that copper can be effectively deoxidized by the addition of various reducing agents such as oils, powdered coal, propane, coke, or sawdust. Fluidjection can be applied to introduce powdered reducing agents into molten copper to improve the reaction efficiency.

Small scale tests were made in which oil was used to deoxidize copper. In these tests, 200 lb. of copper was melted down and then oxidized with copper oxide. Of this, 100 lb. was poured into another crucible and treated with a solid stream of oil injected below the surface of the copper. The remaining 100 lb. was then treated by injecting a similar quantity of oil, which was atomized by nitrogen prior to the injection. The results of these laboratory tests confirmed production tests in that no reduction of the oxygen content in the copper was effected when oil was added as a solid stream. The oil rose to the surface of the molten copper and burned with the evolution of copious quantities of carbon smoke.

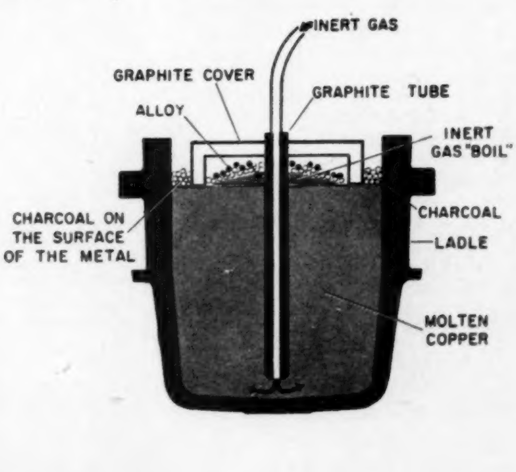


Fig. 1—Arrangement of cover and inlet tube for adding phosphorus-copper alloy using nitrogen stirring

Introduction of oil which had been atomized with 1·3 ft^3 nitrogen prior to injection reduced the oxygen content from an initial 0·64 per cent to 0·07 per cent.

No large-scale tests were made using the nitrogen-oil technique. In full-scale trials, it is expected that the process efficiency would increase, since the metal depth in the anode or cathode furnace is considerably greater than the 8 in. metal depth in the crucible tests. The increase in metal depth is favourable to the reaction, since there would be proportionally greater contact between the oil and the copper when the oil was injected into the deeper baths.

With this nitrogen-atomized oil technique, it was possible to reduce the oxygen content in the copper to a level of 0·008 per cent. Porosity was evident in the test samples cast following this treatment. The porosity was probably caused by separation of dissolved or reaction gases. The dissolved gases can be removed by flushing with an inert gas.

Would it be possible to produce oxygen-free high conductivity copper at lower cost by using the nitrogen-atomized oil technique, followed by inert gas flushing?

At the present time in the steel industry, the more critical grades of steel, such as steel for turbine rotors, are being cast using either an inert gas or a vacuum casting technique. Without these techniques, steel is oxidized by the oxygen in the atmosphere during the teeming operation. The oxidized steel does not fuse back into the ingot body and becomes embedded in the ingot surface. The discontinuities resulting from these oxidized particles cause stress risers, which become ingot surface breaks during working. By means of inert gas purging of moulds or vacuum casting, oxidation of the steel is eliminated and a sounder ingot is cast.

Can inert gas mould purging be applied in the copper industry to overcome some of the problems experienced with defects on the billets, cakes, and bars? In this case, nitrogen could be used as the purging gas, since nitrogen does not enter into reactions with copper, and the solubility of nitrogen in copper is extremely low.

Men and Metals

It has been announced by Birfield Limited that **Mr. Eric Walker** has been appointed managing director of The Phosphor Bronze Company Limited (a member of the Birfield group). Mr. Walker has been associated with the group since 1948; originally works director and then sales director of Kent Alloys Limited, he has for the past year been director of the Aviation and Engineering Divisions of Birfield Industries Limited.

Other appointments made within the Phosphor Bronze Company are as follows:—**Mr. Philip A. Broadbent**, A.M.I.Mech.E., is to be works manager to the company; **Mr. Jack Kitchen** will be sales manager, and **Mr. Gordon Swinyard,** M.Sc., A.I.M., will be chief metallurgist. Mr. Swinyard was with J. Stone and Company from 1939 to 1953, and joined Birfield Industries Limited as metallurgical consultant this year after being a full-time lecturer at Acton and Brunel Technical Colleges.

In succession to **Mr. A. C. Benning**, who has returned to the United States, **Mr. T. I. Williams** has been appointed managing director of Harshaw Chemicals Limited. It is understood that Mr. Benning will retain his seat on the board of directors of the company.

A unit of the Chemicals Division of The British Oxygen Company Limited, Carbides Industries Limited have appointed **Mr. R. A. Millar Craig**, B.Sc., A.M.I.Mech.E., A.M.I.Chem.E., to be general works manager for the new factory which is now under construction for the company at Maydown, Londonderry.

Appointed directors of Colvilles are **Lord Clydesmuir, Mr. J. A. Kilby** and **Mr. T. J. Smith. Mr. D. Ferguson** and **Mr. E. W. Ferguson** have been appointed special directors, and **Mr. R. Marshall** has retired from the board.

At the annual meeting in London of the Industrial Welfare Society last week, **Sir John Wrightson**, Bt., vice-chairman of Head, Wrightson and Company Limited, was elected to the council of the society. **Mr. Frederick C. Braby,** chairman and managing director of Fredk. Braby and Company Limited, was also elected to the council.

Formerly chief inspector of West Instrument Limited, **Mr. J. C. Driver,** B.Sc., has now been appointed applications engineer of the company, in which position he will be devoting all his time to studying possible applications for West temperature controllers.

Clear Anodized Magnesium

USED under a lacquer or varnish for maximum corrosion protection, a clear anodic coating for magnesium alloys that can be applied in less than a minute has been developed by The Dow Chemical Company, of Michigan, U.S.A. A "metallic look" for magnesium products has usually been obtained by applying lacquer or varnish over the bare metal. The clear anodic treatment plus one of the top coats is claimed to provide much better protection than the top coat alone.

Lacquer or varnish tinted with commercial dyestuffs can be applied over the clear anodic coating to obtain a transparent effect in a wide variety of colours with good permanence.

The treatment is a modification of the standard Dow 17 anodic treatment. The latter results in yellow or green opaque deposits. The clear anodic treatment uses a 40 V current, compared to 70-90 V for the standard Dow 17. The anodizing baths are identical.

Patents for the new process are applied for in many countries.

The process is as follows: The metal is buffed with a 320-grit abrasive to achieve uniform brightness of the desired lustre, and parts are immersed in an alkaline cleaner for 3 min. to 10 min., then given a cold water rinse. The parts are next immersed in the anodizing bath for less than 1 min., then given a cold water rinse and a hot water rinse. When dry, lacquer or varnish is sprayed on and baked dry (typical time and temperature: 20 min. at 250°F.). Certain lacquers and varnishes can be air dried.

In 20 per cent salt spray tests, magnesium finished with the new treatment plus lacquer or varnish, has passed 500 hr. with virtually no change in appearance.

The anodic treatment can be applied to all forms of magnesium, such as sheet, extrusions, die-castings, and sand castings and forgings.

Research Progress

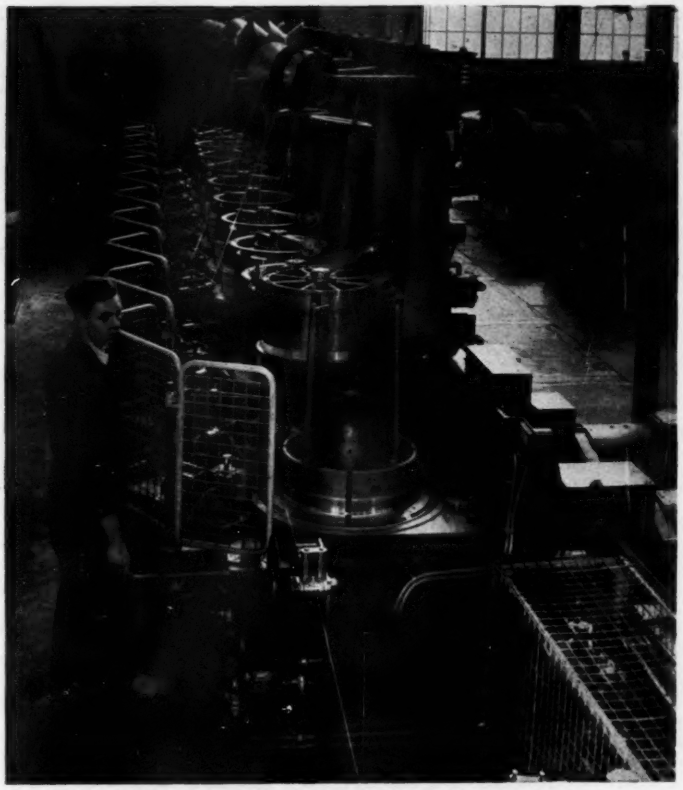
—continued from page 434

description of tests carried out on a variety of sands used in foundries and containing bentonite or fireclay bonding. The results obtained fell "within the same range of values obtained" in the experimental investigations, though this is hardly surprising since the latter included green strengths in the range 3-40 lb/in^2 approximately, and dry strengths up to and exceeding 200 lb/in^2. It would, perhaps, have been of greater interest to show how the detailed observations made could be used to advantage in the foundry, and to discuss in detail how other sand variables, e.g. sand type, particle size, etc., might affect the results.

Reference

1 R. W. Heine, E. H. King and J. S. Schumacher; Amer. Foundrymen's Soc., Preprint No. 58-15, 1958.

Cable Production



Drawing aluminium wire on a Marshall Richards machine

TWENTY-ONE years ago, at a time of considerable depression in South Wales, Aberdare Cables Ltd. was formed. Two bays of the works were built, on a nineteen acre site, and equipped with ten-ton travelling cranes and served with sidings from the main line railway. Planned to secure an uninterrupted flow of cable through all stages of manufacture, this layout has survived successive expansions because it is still considered to be the best of its kind.

Copper is drawn on multiple die "slip" machines, in which an even tension is achieved by allowing the wire to slip on the driving drums, which are driven faster than the wire speed. Aluminium, however, being a much softer material, must be drawn on "non-slip" machines if a good surface finish is to be obtained, and for this reason a modern wire drawing machine has been installed specifically for aluminium, in which each drawing head has an individual speed control with indication when slip occurs and provision for accumulating excess wire if successive heads are not exactly in step. The machine is also equipped with an accumulator head at the output end which permits the changing of the take-up drum without stopping the wire drawing process, thus preventing the snatch which must occur with frequent stopping and starting.

The incidence of corrosion when copper and aluminium are in contact is well known and has provoked considerable controversy over the drawing of copper and aluminium on the same machine. An investigation into this feature has shown quite conclusively that, for paper insulated cables subjected to a drying and impregnation process, and from which all moisture is excluded in service, fear of corrosion is quite unfounded.

After drawing, copper wire is bright annealed under controlled conditions, but aluminium may be used in the three-quarter hard condition as drawn, both being subjected to mechanical and physical testing by the laboratory to ensure compliance with specification requirements.

Circular and shaped stranded conductors are produced from the drawn wire, the shaped conductors having a pre-spiral imparted during the shaping operation to permit laying up without strain on the dielectric. Great care is taken at all stages to prevent damage to the strand and, whenever possible, hardwood dies are used. All strand is subjected to a test routine before the paper dielectric is applied.

Insulation

The insulating paper must satisfy the requirements of texture, complete absence of metallic inclusions and deleterious substances, adequate mechanical strength, and many other general quality clauses which appear in the various cable specifications. To ensure standardization, the company has prepared a specification against which all paper is purchased and rigorously tested before use.

During installation, a cable may undergo quite considerable mechanical handling, and proving tests, such as the Bending Test of B.S.S.480, have been devised to simulate this feature. The dielectric will be subjected to mechanical strain, and displacement of the paper tapes, by a sliding action, must occur if torn or damaged papers are not to result. Experience, backed by laboratory tests, has shown that by arranging 70 per cent of one tape to be covered by the next, i.e. a registration of 30:70, a paper gap of nominally 0·04 in. and an accurate control of tension, a flexible dielectric is possible which is both electrically and mechanically sound.

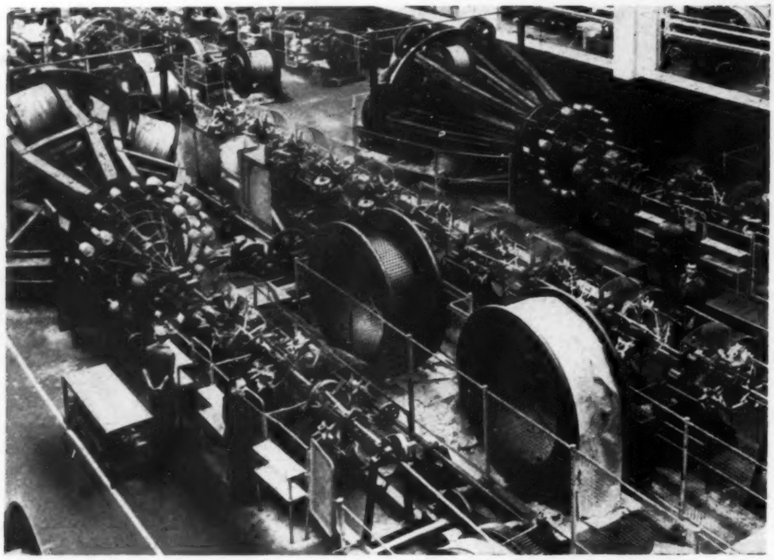
The service which may be expected from any cable must be closely associated with the quality of the dielectric and this, in turn, must depend upon the care and control of the processing by which a hygroscopic material such as paper is converted into a high grade insulant.

The cables are accommodated in hermetically sealed tanks, dried, and the moisture-laden atmosphere is withdrawn by rotating vacuum pumps.

Cables required for operation at high dielectric stresses call for further special consideration, and the electrical characteristics of the dielectric are manually measured during drying, indicating when all the moisture has been removed from the paper, again during impregnation to ensure complete penetration by the compound, and subsequently, during cooling, the conductor temperature is measured to provide a control over the cooling rate.

The impregnating plant is divided into three entirely separate units, each comprising the impregnating tanks, a compound storage vessel, transfer pumps, and associated equipment. Each system contains a different grade of cable saturant suitable for low tension, super tension, and non-draining types of cable respectively.

Impregnating compounds are of paramount importance, consisting of a high-grade mineral oil with highly refined rosin to provide the required temperature - viscosity characteristic. Non-draining types of compound are basically similar but contain small additions of micro-crystalline wax, which modify the viscosity characteristic in such a way that at all operating



Laying up cable

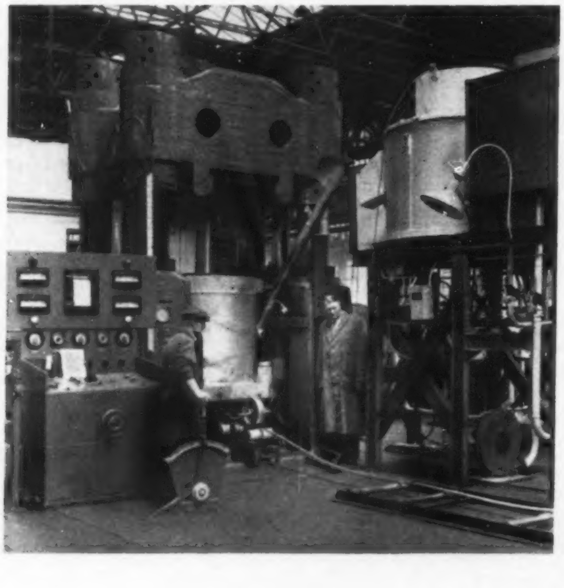
temperatures the compound is in the plastic phase, and thus does not drain away from the paper, but at the impregnating temperature it is sufficiently fluid to provide complete penetration.

Sheathing

Immediately on removing the cables from the impregnating tanks, they are sheathed with a continuous extrusion of lead or lead alloy from hydraulically-operated ram type lead presses, arranged with electrically-heated and thermostatically-controlled die boxes. The unsheathed cable, on the input side to the machine, rotates in a tank of impregnating compound, completely sealing the dielectric from the possibility of moisture ingress.

Many types of lead alloy sheaths are available, and reference is made to them in B.S.S.801, each being suitable for particular conditions of installation. The control of the alloying elements is, however, very critical, and calls for accurate chemical and microscopic analysis at all stages throughout the process, from the supplies of pig lead, lead melting pot, and from the extruded cable sheath.

Mechanical protection for the lead sheath, in the form of steel tape or wire with bitumen impregnated textile beddings and servings, is normal practice on most underground cables, and the factory is suitably equipped for their application. Some installation conditions may require special servings such as colour coding for identification, fire-resisting, termite repelling, high ambient temperature, or protection against corrosion from chemical, micro-biological and electrolytic attack, and suitable recommendations can be made. The latter, anti-corrosive servings, has been the subject of a considerable investigational programme over a number of years both by laboratory methods and buried cable undergoing simulated service conditions. Undoubtedly, the most complete protection is provided by an extruded P.V.C. sheath, and the factory is equipped for this process, but an economic and very reliable alternative may be found in the application of two P.V.C. tapes, each 0·01 in. thick, with added mechanical protection of bituminized textile servings.



Lead-sheathed cables emerging from the Loewy sheathing press

Testing

The very nature of cable manufacture does not lend itself to detailed testing at intermediate stages of production, and it is thus imperative that the raw materials are of a consistent and high order of quality. Every item of material which enters the factory is thoroughly tested in the physical and chemical laboratories before issue to the manufacturing departments, and many of them are purchased and tested in accordance with the company's own specifications, which have been developed after laboratory investigations and experience of manufacturing and service conditions. Where process conditions permit, intermediate testing, such as drawn wire, completed strand, and stored compound, is carried out, and after manufacture tests are carried out on the completed cable.

Obituary

Mr. F. R. Stagg

WE regret to record the death of Mr. Frank R. Stagg, M.I.Struct.E., deputy chairman of Thos. W. Ward Ltd. Mr. Stagg joined the company in 1895, took over management of the constructional department in 1906, and was appointed a local director in 1919 and a director in 1927. In 1938 he was made assistant managing director, and became deputy chairman in 1950.

At the time of his death, Mr. Stagg was chairman and managing director of The Ketton Portland Cement Co. Ltd., Thomas Smith and Sons (Rodley) Ltd., John Smith (Keighley) Ltd., Widnes Foundry and Engineering Co. Ltd., and The Shap Granite Co. Ltd. He was alternate chairman, and also managing director, of Ribblesdale Cement Co. Ltd. and its subsidiaries.

Mr. E. J. Waddington

IT is with regret we record the death of Mr. E. J. Waddington, a director of Vickers Limited and of Vickers-Armstrongs Limited and, until recently, of many subsidiary companies of Vickers Limited. He was appointed to the board of Vickers-Armstrongs Limited in March, 1950, and to the board of Vickers Limited in January, 1955, becoming director of administration of Vickers Limited on January 1, 1955; on April 1, 1957, he was appointed director of finance of that company.

Industrial News *Home and Overseas*

Golden Jubilee Year

It was in 1908 that Mr. James Arthur Reavell, M.I.Mech.E., M.I.Chem.E., F.Inst.F., F.I.M., founded the **Kestner Evaporator and Engineering Company Ltd.**, and in commemoration of fifty years of chemical engineering endeavour, a book of some 100 pages has been published in which many interesting notes regarding the activities and achievements of the company are recorded.

In a foreword, Mr. Reavell details the events leading up to the formation of the company, some notes on his own early history, and his meeting with Paul Kestner. Although the company is completely independent of the French Kestner company, Mr. Reavell stresses that both companies have always maintained the closest co-operation and exchange of technical information.

The book is divided into nine chapters under the following headings:—evaporation; drying; acid handling; Keebush and other acid-resisting materials of construction; high-temperature process heating; effluents and their treatment; complete process plant installations; education; and overseas activities.

There is very much of interest in Mr. Reavell's memories of the past fifty years of his company, and the various activities of the firm are well set out and accompanied by many illustrations and diagrams.

Science on Show

A new type of exhibition is to be held at Olympia, London, in October of next year. The **International Scientific Research Exhibition** is being organized to illustrate the story of scientific achievement; to demonstrate the influence scientific development plays in our daily life; and to explain the promise scientific discovery and research holds for the future.

Four main themes have been chosen as the pattern for the exhibition: health and food; materials; transport and communications; power and industry. For the first time, universities are being encouraged to take part in a public exhibition so that they can make known the very important part they are playing in modern technical and scientific research in all fields.

In the power and industry section of the exhibition, aspects of power resources available to man, from the gas turbine to the atomic reactor, will be shown. Upon the development of power resources relies the ability of industry to produce goods of all kinds on a vast scale.

Export Credits and Engineering Goods

It has been announced by the Export Credits Guarantee Department that it has simplified arrangements for cover on those engineering goods commonly sold on credit terms ranging from six months to three years maximum, whatever the unit value of those goods, which are covered by "Extended Terms" endorsements or memoranda attached to the normal short-term cover. The normal short-term cover will continue to apply to raw materials and consumer goods. (For one class of consumer goods—motor cars—terms in excess of six months have been, and will continue to be, covered on a case by case basis.)

Hitherto the credit terms acceptable for insurance within this field have been decided for each application for cover on an individual transaction. E.C.G.D. has now informed such policyholders that they can assume there will be no objection to credit terms up to two years maximum in respect of orders of £20,000 or more for either commercial credit users (such as distributors) or for end-user buyers; and that there will be no objection to terms up to three years maximum for orders of £50,000 or more for end-user buyers.

It is hoped that this will relieve exporters of uncertainty as to credit terms in much of the Extended Terms field, and thereby assist them in negotiation of business. Where the exporter seeks to give credit for longer periods than provided for above, it will still be necessary for him to make an individual case to E.C.G.D., and in all cases E.C.G.D. retains underwriting discretion as to the other elements of a contract.

New Etch Primer

In the constant battle to beat rust and corrosion in metals, a new etch primer has just been put on the market by **Federated Paints Ltd.** This is a new version of the original Strathclyde etching primer. It is stated by the company that this Primer (PA-10), because of its stability, ensures the uninterrupted application by spray gun which is so essential in automation. It is equally effective applied by brush, spray, or by dipping, and by any of these methods air-dries quickly in 30 min. It may be stoved for even quicker drying.

It is explained that this is not a paint, but a metal conditioner. On aluminium sheeting, zinc sprayed metals, shot-blasted steel, and on all ferrous as well as non-ferrous metals, it bonds itself to the surface by means of its eching action. Its adhesion on mild steel, or on cadmium plate, is stated to be such that it would require over 3,000 lb/in^2 to remove it. The manufacturers are making available free sample tins of this primer as a means of substantiating their claims.

Compressed Air Presses

A new range of Wasa bench air presses is being introduced into this country by the **Addison Tool Company Ltd.** The range consists of presses from 400 lb.-1½ tons pressure at 80 lb/in^2. Various types of hand and foot valves are available. These presses are stated to be extremely economical in air consumption, their application to industry is very wide, and the price is low.

An Anniversary

On Thursday of last week, **Aberdare Cables Ltd.** celebrated their twenty-first anniversary with a works open day, and on the following day (Friday) some 500 members of the company and their wives attended a dinner at the City Hall, Cardiff, to celebrate the event and to inaugurate the Long Service Association.

The founder chairman of the company, Sir George Usher, and the present chairman, Sir John Pascoe, have both served 21 years and become founder members, together with 26 others, most of whom come from the town of Aberdare.

The original factory site was 19 acres, and the buildings completed in 1938 had a total floor space of 63,000 ft^2. Over the intervening period of 21 years, extensions have been going on, and to-day the factory employs more than 400 people. More cable of greater variety is being made than at any time in the history of the company. Still further expansion is planned, and a 12-acre site has been bought near the present works and development has already begun.

Lead and Zinc Conference

At the close of the 30-nation conference on lead and zinc, held in Geneva last week, it was announced in an official communique that it had been decided to set up an international study group on the two metals. The conference unanimously agreed to continue an urgent review of the current situation at Governmental level. The committee chosen for this task, set up after a London conference in September, has been enlarged, the communique said. Its task is to consider methods of meeting difficulties in current international trade and to examine the possibility of drafting a short-term commodity agreement. The committee will report back to a further conference, whose time and place will be arranged by the U.N.

The communique said some Governments were, in principle, in favour of cuts in production, but others foresaw practical difficulties. The main exporting countries could not agree on limiting exports to markets outside the U.S., the communique said. But the Governments concerned were in close touch with the mining industries' adjustments to the changing situation. Some Governments thought that export cuts would not be practicable; others stressed that the conference should have regard to the effect of U.S. import cuts on lead and zinc.

Action to promote long-term stability of prices and sound conditions in markets was also discussed, and a number of countries declared such action was desirable if most exporting and importing countries took part. Some Governments thought the study group would be unnecessary to cope with the present situation, and that the need for consultation would be met by the lead-zinc committee. They believed the study group could only contribute to a long-term solution of the unbalance between output and consumption.

The conference also referred to the possibility of consultations with the General Agreement on Tariffs and Trade.

Countries attending the conference were: Australia, Belgian Congo, Belgium, Britain, Canada, Cuba, Chile, Czechoslovakia, Denmark, Dominican Republic, France, West Germany, Greece, Israel, Italy, Japan, Mexico, Netherlands, Norway, Peru, Poland, South Africa, Soviet Union, Spain, Sweden, Switzerland, Tunisia, Turkey, United States, and Yugoslavia.

The Federation of Rhodesia and Nyasaland, Bulgaria, Uruguay and Venezuela attended as observers.

Members of the newly-formed Aluminium Division of the Vitreous Enamel Development Council at Banbury works of Northern Aluminium Company Limited

An Aluminium Section

An inaugural meeting of the new aluminium section of the **Vitreous Enamel Development Council** was held recently at the Banbury works of the Northern Aluminium Co. Ltd. It was attended by eighteen directors and executives of companies engaged in various aspects of vitreous enamelling. At the meeting, the first steps were taken towards the provision of a closer liaison between interested organizations and the establishment of a firmer and more formal place in industry and commerce.

In his address, the chairman stated that the production of a vitreous or porcelain finish on aluminium has been possible for several years, but only comparatively recently has it been put to commercial use. Considerable use for vitreous-enamelled aluminium is foreseen in architecture and in many other fields.

The members attending the meeting afterwards toured the production plant at the Banbury works and showed considerable interest in the laboratories, where they were able to see examples of vitreous enamel on aluminium which could be cut, drilled and sawn with negligible chipping.

London Offices

From Monday next (November 24), the London offices of **Metropolitan-Vickers Electrical Co. Ltd.** will be situate at 33 Grosvenor Place, London, S.W.1, with the telephone number of Belgravia 7011. This change of address also concerns the London district office of **The British Thomson-Houston Co. Ltd.**, who will share the same building and telephone number.

Bending Beryllium Tubes

Recent news from **Tube Investments Ltd.** is to the effect that at the company's technological centre at Walsall it has fabricated a small bore beryllium tube of sufficient ductility to permit bending it on a 5 in. radius. The tube is of 0·3 in. bore with a wall thickness of 0·04 in.

The Tin Situation

In their latest review of the tin market, **A. Strauss and Company** say that there is now ample evidence of an increasing shortage of this metal. Not only has the buffer stock floor level been maintained without any action on the part of the manager, but, as the result of the interplay of supply and demand, the price has been mounting steadily until, at the time of writing, it is approaching the figure at which the stock can be sold, the review says. Prices would probably have risen more sharply but for the knowledge that the metal bought with the special fund can be liquidated at any time the Council chooses before the price reaches £780.

In answer to the question to what extent will the threat of execution of such sales prevent higher prices being reached, the company say the basic fact of the situation is that under the existing export restriction quotas there is an annual deficit, calculated on a pessimistic estimate of consumption prospects of at least 25,000 tons, equivalent to 2,000 tons a month. It was reasonable to assume there would be no increase, or at least no substantial increase, in the export quotas until the buffer stocks had been greatly reduced, and that the sale of a large part of it would have priority.

It was believed that the special fund holdings amounted to about 4,500 tons. Although this was an estimate, it could not be far out. The Tin Council would obviously not want to sell this metal in a manner likely to depress prices, nor in view of the basic strength of the tin position was there any need to hurry. But the liquidation of all this stock will do no more than fill the gap between supply and consumption for two months. Thereafter, the market would have to wait until the London Metal Exchange price reached £780 before the buffer stock manager could sell any more metal. And he would only be able to continue doing so as long as the price was maintained at that level.

The Engineering Centre

Exhibitors at the Birmingham Exchange and Engineering Centre, at Stephenson Place, Birmingham, have their headquarters in all parts of Great Britain. A study of the list of exhibitors does, in fact, show that over 60 per cent of the exhibitors are outside the Birmingham area. The present title of the centre has, at times, led to misunderstandings both with home and overseas contacts due to the inference that it is an exhibition of Birmingham firms only.

To overcome this difficulty and to simplify the title of the organization, it is announced that in future the title of the concern will be **"The Engineering Centre."** It should be noted that this is a change of title only and implies no alteration to the structure or operation of the centre.

It is interesting to recall that the Birmingham Exchange was founded over 90 years ago, and it was in 1954 that the present premises were transformed and opened as the Birmingham Exchange and Engineering Centre, an innovation which has proved to be successful in many ways.

A Demonstration Unit

New additions to the range of ultrasonic flaw detection equipment manufactured by **Kelvin and Hughes (Industrial) Ltd.**, will be displayed in the company's mobile demonstration unit in Olympic Way, Wembley, Middx., from Monday next until Wednesday next. This three-day private exhibition will preface a demonstration tour of industrial areas throughout the United Kingdom, beginning with a visit to the Midlands on December 1 next.

The tour is designed to show industry the latest developments and facilities available in the techniques of ultrasonic flaw detection and high frequency recording, and on view for the first time will be entirely new developments in the general field of non-destructive equipment.

At Coryton Refinery

It is announced by **Mobil Oil Company Ltd.** that constructors **John Brown Ltd.** are well advanced with the building of a large liquefied petroleum gases recovery unit at their Coryton refinery. This unit will add to the range of finished products now available from Coryton.

Temperature Control Equipment

In the New Year, a London office is to be opened by **West Instrument Limited,** the manufacturers of temperature control equipment. Two area managers have been appointed, and will be responsible for the company's sales and service in London and the home counties. Both will take up their duties on January 1 next.

U.K. Metal Stocks

Stocks of refined tin in London Metal Exchange official warehouses at the end of the week to November 15 totalled 17,282 tons, comprising London 6,050; Liverpool 9,727, and Hull 1,505 tons. A week before, the aggregate was 17,421 tons, divided into London 6,112 tons; Liverpool 9,804, and Hull 1,505 tons.

Copper stocks totalled 6,096 tons, and comprised London 4,375; Liverpool 1,446; Birmingham 25; Manchester 250, and Swansea nil. In the week to November 8 they were 5,979 tons, comprising London 4,375 tons; Liverpool 1,304; Birmingham 25; Manchester 250, and Swansea 25 tons.

Soviet Seven-Year Plan

Recent news from Moscow is to the effect that the seven-year development plan for the Soviet economy, published in *Pravda*, states that by 1965 aluminium output will be 2·8 times the 1958 level, and that of refined copper 1·9 times. (On the basis of recent U.S. estimates for 1957 and 1956, allowing for a regular increase,

this would give a 1965 output for aluminium of 1,568,000 metric tons, and for copper of 817,000 metric tons.) Large increases are also planned in output of nickel, magnesium, titanium, germanium and silicon. It is intended to set up a large aluminium industry in the Krasnoyarsk area. Production of aluminium in that area will be based on local deposits of nephelites. It is proposed to use the increased aluminium output more widely in the engineering, shipbuilding and motor vehicle industry.

Safety in Industry

A new Safety Training Centre for foremen and others in the building and civil engineering industry was opened on Wednesday last at the Government Training Centre, Enfield. The opening ceremony was performed by The Hon. Richard Wood, M.P., Parliamentary Secretary to the Ministry of Labour and National Service. The establishment of this training centre marks a further development in the co-operation between the Government and industry in a drive to cut down the number of accidents on building and civil engineering sites.

The London Building and Engineering Contractors' Accident Prevention Group have been given the use of land and buildings at the Centre, and member firms of the group have contributed money, materials and equipment to erect the shell of a two-storey building and to dig a trench which can be used to illustrate different methods of timbering excavations. Scaffolding is erected round the demonstration building to show the right and the wrong way of doing the job. It is expected that there will be about six courses a year, each accommodating thirty students. These students will be building foremen and others whose everyday duties involve the maintenance of safety standards during building operations. Each course will last two days and will consist of lectures, demonstrations and practical exercises. The lecturers will be drawn from safety experts in the industry itself and from members of H.M. Factory Inspectorate.

The courses will be similar in character to those which have been run with conspicuous success at the Birmingham Industrial Safety Training Centre over the past two years. Although the Ministry of Labour will co-operate as far as possible in the running of the courses, the general control of them, and the responsibility for them, will rest entirely with the London Building and Engineering Contractors' Accident Prevention Group.

Graphite Products

It has been announced that Great Lakes Carbon International Limited, with sales offices at 140 Park Lane, London, W.1, has been appointed sales representative for all commercial products of the new **Anglo Great Lakes Corporation Ltd.** graphite plant at Newcastle upon Tyne. In addition, the company will also market graphite products of the U.S.A. company throughout the United Kingdom and Western Europe. This appointment will offer the electro-metallurgical and electro-chemical industries in these areas an extensive line of highest quality electrodes, graphite anodes and graphite specialities.

Gauge and Tool Makers

There is to be a luncheon for representatives of members of the **Gauge and Tool Makers' Association** at the Savoy Hotel, London, on Thursday of next week (November 27). This will be followed by the annual general meeting of the association.

During the luncheon there will be an address by the President of the association, Mr. F. W. Halliwell, C.B.E., M.I.Mech.E., following which association certificates of craftsmanship and certificates of gauge and tool design and draughtsmanship will be presented by the President and chairman to successful applicants during the past twelve months.

Luncheon Club Meeting

Early notice is given of the next meeting of the **Finishing Luncheon Club,** which is to be held at the Rembrandt Hotel, London, on Thursday, December 18 next, at 12.15 p.m., and at which the guest speaker is to be Mr. Jack Train.

Welding School in Ulster

More than 200 enquiries are reported to have been received from students wishing to attend the first welding school to be established in Northern Ireland. This school has been opened by **British Oxygen Gases Limited** at its premises in Castlereagh, Belfast. It has accommodation for eight men on oxy-acetylene welding, one on electric arc welding, one on hand cutting techniques, and a further one on machine cutting techniques.

Specialist courses are being provided at the school in pipe welding for heating and ventilating engineers, lead and bronze welding for the plumbing trades, and light gauge sheet and tube welding for the aircraft, automobile and sheet metal industries. Facilities are also provided for the demonstration of flame cleaning, argon welding and machine cutting. A range of cutting machines has been installed, and oxygen is supplied to these machines and to the welding benches through a pipeline.

The new school has a cinema, and films and lectures are being provided for a maximum of 30 people on specialist welding techniques and the safe handling of equipment. Apprentices with no previous experience of welding can enrol at the school for courses lasting approximately eight weeks, and courses of shorter duration are being provided for men who already possess welding knowledge.

Bronze and Brass Founders

An open meeting of the **Association of Bronze and Brass Founders** for members in the Yorkshire area is to be held at the Victoria Hotel, Bradford, on Monday, December 1 next, for the purpose of discussing the subject of "Costing a Casting." Arrangements have been made for luncheon at 1 p.m., and following luncheon, J. Blakeborough and Sons Ltd. have invited members to visit their works.

A meeting of members of the association in the Lancashire and Cheshire area is to be held at the Engineers' Club, Manchester, on Monday next, November 24, at 4.30 p.m.

Japan's Aluminium Output

According to recent news from Tokyo, Japan's annual production of primary aluminium is likely to rise to 112,000 tons by March, 1960, on the basis of refineries' expansion programmes and the bright prospects for the industry. Demand for the metal is steadily increasing and now exceeds domestic supply.

The Japanese Ministry of Trade said the present expansion programmes provided that output of primary aluminium would reach 105,200 tons by March, 1959, representing an increase of 8,600 tons from that of a year ago. This increase would be obtained by re-activating an old plant in Niigata, northern Japan, owned by the Japan Light Metal Company, a leading aluminium producer. Furthermore, a plant in Kitagata, northern Japan, owned by the Showa Denko Company, another leading aluminium producer, had expanded production capacity.

World Tin

The International Tin Council reports that world output of tin-in-concentrates fell from 11,200 tons in June, 1958, to 10,700 tons in July, and 9,500 tons in August. Production in the Federation of Malaya declined further in September to 2,577 tons. During August, production in the Belgian Congo amounted to 918 tons.

World mine output (excluding the U.S.S.R., China and Eastern Europe) in countries other than the six producer members of the International Tin Agreement, is estimated to have amounted to 2,800 tons in the third quarter of 1958; this compares with 2,600 tons in the second quarter, 2,550 tons in the first quarter, and a quarterly average during 1957 of approximately 2,750 tons.

World smelter production of tin metal showed little change from May to June, when it amounted to 10,800 tons; in July, it rose to 12,600 tons. These totals include an estimated production in the U.S. of about 1,000 tons in June and 2,000 tons in July. Production in the U.S. during August and September is estimated at about 500 tons in each month.

Forthcoming Meetings

November 21—Institute of Metals. Birmingham Local Section. Birmingham Engineering Centre, Stephenson Place, Birmingham. "Corrosion and the Microstructure." C. Edeleanu. 7 p.m.

November 25 — Institute of British Foundrymen. Slough Section. Lecture Theatre, High Duty Alloys Ltd., Slough. "£.s.d. in the Foundry." G. B. Judd. 7.30 p.m.

November 25 — Incorporated Plant Engineers. South Wales Branch. South Wales Engineers' Institute, Park Place, Cardiff. "Corrosion." D. W. Marshall. 7.30 p.m.

November 26 — Institute of British Foundrymen. Southampton Section. Technical College, St. Mary's Street, Southampton. Film Evening. 7.30 p.m.

November 26—The Society of Instrument Technology. Chester Section. Lecture Theatre, Grosvenor Museum, Grosvenor Street, Chester. "Instrumentation in Chemical Analytical Control." B. W. Bradford.

November 28—Institute of Metal Finishing. Sheffield and North-East Branch. Grand Hotel, Sheffield. Open Evening Discussion 7 p.m.

November 28—North East Coast Institution of Engineers and Shipbuilders. Mining Institute, Newcastle upon Tyne. "Tests on Light Alloy Stiffener Sections." M. N. Parker and K. V. Taylor. 6.15 p.m.

November 28—The Society of Instrument Technology. Scottish Section. 425 Sauchiehall Street, Glasgow. "Analytical Instrumentation of Chemical Processes." J. D. Tallantire. 7.15 p.m.

Metal Market News

LAST week saw weakness on the Metal Exchange, and with the exception of zinc, which was very steady, there were all-round losses. Wall Street developed an irregular tendency, but on balance losses were not serious. Nevertheless, confidence in the United States seemed to be a little shaken, but for the most part a bullish atmosphere prevails across the Atlantic. In London, Stock Exchange quotations kept up well, and in spite of some talk of further increases in the volume of unemployment, industrial shares were well favoured. Trading in standard copper was very active, the turnover during official dealing amounting to 12,425 tons, but in addition to this a big business was done on the Kerb market which was probably not less than 1,000 tons. At the beginning of last week, stocks of copper in L.M.E. warehouses were reported 631 tons down at 5,979 tons but, nevertheless, the backwardation narrowed from about £13 to less than £4 as the price of cash fell steeply. This slump in values, for indeed it was little less, was touched off by the American Government's decision to let up on export licences, the supposition being that stocks in the U.K. would build up again, with particular reference to copper on warrant. However, it certainly seemed last week as though consumers had nothing much to buy, and it was even reported that there was some re-selling from the Continent. Be this as it may, the close on Friday afternoon, 10s. above the worst, was £238 10s. 0d. cash and £234 15s. 0d. for three months. These prices showed a decline of £21 10s. 0d. in cash and of £12 in three months. In the States, the Comex price fluctuated from day to day, but there was a downward trend over the week. Producers' and custom smelters' prices were unchanged.

After business on the Kerb came to an end on Friday, with a slightly firmer tendency, it seemed that there was a little more optimism, and this was explained when over the week-end it became known that the Copper Institute had released figures of world stocks of copper at October 31, which showed a reduction of about 100,000 short tons. Naturally, in view of the strikes in progress during October, a fall had been anticipated, but probably there were few who expected to see quite such a large figure lopped off the reserves. Whether buyers will come in as a result of these figures remains to be seen, but it is pretty certain that the view that the fall has been overdone will be confirmed, and we shall, therefore, probably see some speculative buying. At £260, the London quotation was certainly too high, for 30 cents is equal to only £240. Now, however, it is quite likely that we shall have the settlement price up to £250 again, with some widening in the backwardation as the demand for nearby metal revives. Of the other metals, tin was active with some 1,180 tons changing hands, cash closing £9 down at £754 and three months £7 lower at £756. Lead showed weakness, November finishing at £74 5s. 0d., which was £3 10s. 0d. down, and February at £75, a drop of £2 15s. 0d. Zinc was irregular, closing at £75 10s. 0d. prompt and £72 5s. 0d. forward, the backwardation reflecting the scarcity of spot metal. On balance the early position gained 15s., while forward metal lost 7s. 6d.

It is now known for certain that zinc, lead and tin are included in a list of strategic materials for acceptance by the United States in exchange for surplus farm products, but copper, which was listed previously, does not appear in this revised schedule. It remains to be seen whether this action is going to do much to help these metals. In the U.K., stocks of tin show some tendency to decline, and last week saw a drop of 190 tons to 17,421 tons. Consumption in September was 1,784 tons, which is about an average figure and 372 tons up on August. The British Bureau of Non-ferrous Metal Statistics gives refined copper usage in September as 52,018 tons, and secondary at 9,390 tons.

New York

Two leading developments occurred in metals during the week-end. The U.S. Department of Agriculture announced a revised barter programme expanding the list of materials it would accept for surplus farm commodities; 26 minerals are now eligible for barter instead of the 12 previously acceptable. Lead, tin and zinc were the major non-ferrous metals on the list. Copper was dropped. Traders said it was too early to tell how the new barter deals would affect the market, but noted that the Department of Agriculture would administer the programme with the view of expanding the total exports of agricultural commodities without disrupting the world markets.

The other leading non-ferrous metals development was the October copper statistics, which showed a drop of more than 100,000 tons in world stocks of copper. U.S. stocks dropped about 50,000 tons. Traders said the Rhodesian, International Nickel and U.S. strikes, as well as increased demand here and abroad, were the main factors in the bullish statistics. However, custom smelters said sales to-day continued modest, with the export price below the domestic custom smelter level. Producers reported continued active demand. Lead and zinc were modestly active, while tin, after early softness, steadied on the barter announcement.

Nearly 500,000 tons of aluminium may be needed in the coming year for use in constructing new homes and in repairs, modernization and improvement of existing residential facilities, according to an official in the Building Supply Industry. Mr. Harry Sugar, President of Alsco Incorporated, said that, indicative of the rise, sales by his firm in 1958 were running 41 per cent ahead of last year. He added that it was safe to forecast an increase of 500 per cent in residential construction consumption over the next five years, with an amount equal to 200 lb. of aluminium going into the average house.

Birmingham

Little change has taken place in the general trend of business in the metal industries in the Midlands. Buyers of non ferrous metal are moving cautiously. The continued prosperity in the motor trade, which has been reinforced by valuable business booked in overseas markets recently, finds employment not only for those immediately engaged in it, but for thousands more in the industries producing components. The cycle trade is still working below capacity and manufacturers are disturbed at the prospects for the immediate future. The building industry has slowed down, bringing less demand for builders' ironwork and brass fittings. Makers of domestic oil appliances are well employed.

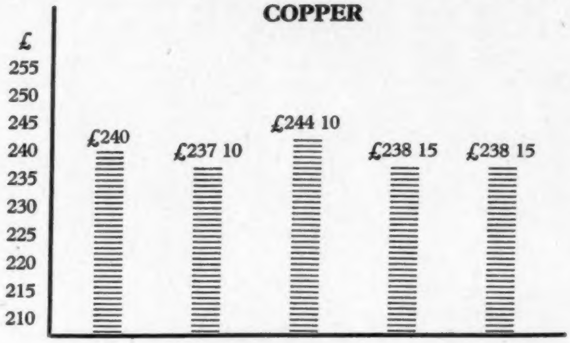
Stocks of iron and steel have been reduced slightly in the last month, and this is apparently due to the fact that users have been content to use material on hand rather than place new business. There is no immediate prospect of any return to more active conditions. There is a good deal of unemployment in Black Country iron foundries. Re-rollers cannot find sufficient orders to warrant a full week's work. Tube mills are less active. On the other hand, the demand for steel sheets is sustained, and plate mills are still well employed on orders for tank and boiler makers.

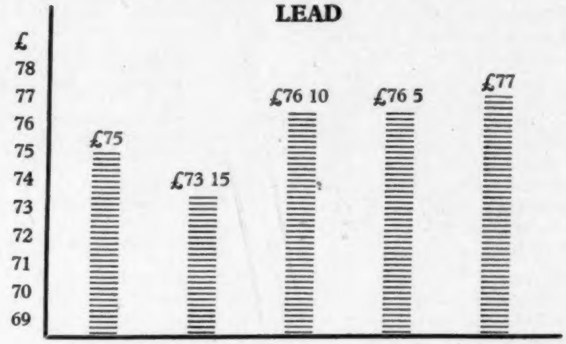
Western Germany

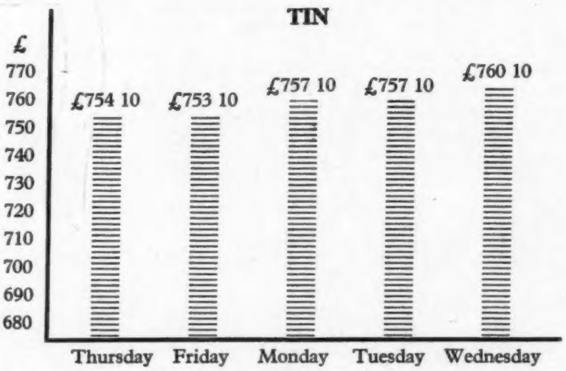
The West German duty-free import quota of 40,000 tons of aluminium a year is expected to be maintained during 1959, Government sources have stated. A motion to approve the extension of the quota for another year was expected to be submitted to Parliament shortly, the sources said. West German aluminium producers had been pressing for the abolition of the quota, but the processing industry said it should be maintained because domestic production was not enough to meet all requirements.

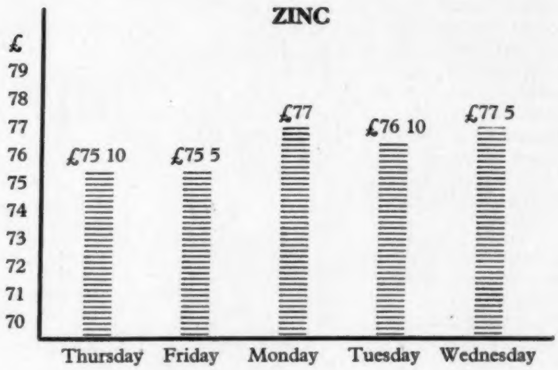
METAL PRICE CHANGES

LONDON METAL EXCHANGE, Thursday 13 November 1958 to Wednesday 19 November 1958









OVERSEAS PRICES

Latest available quotations for non-ferrous metals with approximate sterling equivalents based on current exchange rates

	Belgium fr/kg	≏£/ton	Canada c/lb	≏£/ton	France fr/kg	≏£/ton	Italy lire/kg	≏£/ton	Switzerland fr/kg	≏£/ton	United States c/lb	≏£/ton
Aluminium			22.50	185 17 6	210	182 15	375	217 10			26.80	214 10
Antimony 99.0					195	169 12 6	430	249 10			29.00	232 0
Cadmium					1,500	1,305 0					145.00	1,160 0
Copper												
Crude												
Wire bars 99.9							480	278 10				
Electrolytic	34.50	252 2 6	28.25	233 7 6	307	267 0			3.00	250 17 6	29.00	232 0
Lead			11.25	93 0	115	100 0	182	105 10	.91	76 0	13.00	104 0
Magnesium												
Nickel			70.00	578 5	1,205	1,048 7 6	1,300	754 0	7.56	632 2 6	74.00	592 0
Tin	107.75	787 12 6			946	823 0	1,440	835 5	8.70	727 10	98.87	791 0
Zinc												
Prime western			11.00	90 17 6							11.50	92 0
Highgrade 99.95			11.60	95 17 6								
Highgrade 99.99			12.00	99 2 6								
Thermic					107.12	93 2 6						
Electrolytic					115.12	100 2 6	175	101 10	.92	77 0	12.75	102 0

NON-FERROUS METAL PRICES

(All prices quoted are those available at 2 p.m. 19/11/58)

PRIMARY METALS

		£	s.	d.
Aluminium Ingots	ton	180	0	0
Antimony 99·6%	„	197	0	0
Antimony Metal 99%	„	190	0	0
Antimony Oxide	„	180	0	0
Antimony Sulphide Lump	„	190	0	0
Antimony Sulphide Black Powder	„	205	0	0
Arsenic	„	400	0	0
Bismuth 99·95%	lb.		16	0
Cadmium 99·9%	„		9	6
Calcium	„	2	0	0
Cerium 99%	„	16	0	0
Chromium	„		6	11
Cobalt	„		16	0
Columbite .... per unit			—	
Copper H.C. Electro	ton	238	5	0
Fire Refined 99·70%	„	237	0	0
Fire Refined 99·50%	„	236	0	0
Copper Sulphate	„	79	0	0
Germanium	grm.			
Gold	oz.	12	10	1½
Indium	„		10	0
Iridium	„	20	0	0
Lanthanum	grm.		15	0
Lead English	ton	77	0	0
Magnesium Ingots	lb.		2	5½
Notched Bar	„		2	10½
Powder Grade 4	„		6	3
Alloy Ingot, A8 or AZ91	„		2	8
Manganese Metal	ton	290	0	0
Mercury	flask	78	0	0
Molybdenum	lb.	1	10	0
Nickel	ton	600	0	0
F. Shot	lb.		5	5
F. Ingot	„		5	6
Osmium	oz.	nom.		
Osmiridium	„	nom.		
Palladium	„	5	15	0
Platinum	„	21	5	0
Rhodium	„	40	0	0
Ruthenium	„	15	0	0
Selenium	lb.	nom.		
Silicon 98%	ton	nom.		
Silver Spot Bars	oz.		6	5¼
Tellurium	lb.		15	0
Tin	ton	760	10	0
***Zinc**				
Electrolytic	ton		—	
Min 99·99%	„		—	
Virgin Min 98%	„	75	15	0
Dust 95/97%	„	104	0	0
Dust 98/99%	„	110	0	0
Granulated 99+%	„	100	15	0
Granulated 99·99+%	„	115	2	6

**Duty and Carriage to customers' works for buyers' account.*

INGOT METALS

Aluminium Alloy (Virgin)		£	s.	d.
B.S. 1490 L.M.5	ton	210	0	0
B.S. 1490 L.M.6	„	202	0	0
B.S. 1490 L.M.7	„	216	0	0
B.S. 1490 L.M.8	„	203	0	0
B.S. 1490 L.M.9	„	203	0	0
B.S. 1490 L.M.10	„	221	0	0
B.S. 1490 L.M.11	„	215	0	0
B.S. 1490 L.M.12	„	223	0	0
B.S. 1490 L.M.13	„	216	0	0
B.S. 1490 L.M.14	„	224	0	0
B.S. 1490 L.M.15	„	210	0	0
B.S. 1490 L.M.16	„	206	0	0
B.S. 1490 L.M.18	„	203	0	0
B.S. 1490 L.M.22	„	210	0	0

		£	s.	d.
†Aluminium Alloys (Secondary)				
B.S. 1490 L.M.1	ton	144	0	0
B.S. 1490 L.M.2	„	152	0	0
B.S. 1490 L.M.4	„	169	0	0
B.S. 1490 L.M.6	„	187	0	0

†Average selling prices for mid September

		£	s.	d.
***Aluminium Bronze**				
BSS 1400 AB.1	ton	230	0	0
BSS 1400 AB.2	„	238	0	0
***Brass**				
BSS 1400-B3 65/35	„	151	0	0
BSS 249	„		—	
BSS 1400-B6 85/15	„		—	
***Gunmetal**				
R.C.H. 3/4% ton	„		—	
(85/5/5/5)	„	192	0	0
(86/7/5/2)	„	203	0	0
(88/10/2/1)	„	249	0	0
(88/10/2/½)	„	264	0	0
Manganese Bronze				
BSS 1400 HTB1	„		—	
BSS 1400 HTB2	„		—	
BSS 1400 HTB3	„		—	
Nickel Silver				
Casting Quality 12%	„	nom.		
„ „ 16%	„	nom.		
„ „ 18%	„	nom.		
***Phosphor Bronze**				
B.S. 1400 P.B.1 (A.I.D. released)	„	285	0	0
B.S. 1400 L.P.B.1	„	218	0	0
Phosphor Copper				
10%	„	258	0	0
15%	„	261	0	0

**Average prices for the last week-end.*

		£	s.	d.
Phosphor Tin				
5%	ton		—	
Silicon Bronze				
BSS 1400-SB1	„		—	
Solder, soft, BSS 219				
Grade C Tinmans	„	358	3	0
Grade D Plumbers	„	290	3	0
Grade M	„	392	6	0
Solder, Brazing, BSS 1845				
Type 8 (Granulated)	lb.		—	
Type 9 „	„		—	
Zinc Alloys				
Mazak III	ton	108	7	6
Mazak V	„	112	7	6
Kayem	„	118	7	6
Kayem II	„	124	7	6
Sodium-Zinc	lb.		2	6½

SEMI-FABRICATED PRODUCTS

Prices of all semi-fabricated products vary according to dimensions and quantities. The following are the basis prices for certain specific products.

Aluminium		£	s.	d.
Sheet 10 S.W.G.	lb.		2	8½
Sheet 18 S.W.G.	„		2	10½
Sheet 24 S.W.G.	„		3	1¼
Strip 10 S.W.G.	„		2	8¼
Strip 18 S.W.G.	„		2	9¼
Strip 24 S.W.G.	„		2	11
Circles 22 S.W.G.	„		3	2½
Circles 18 S.W.G.	„		3	1¾
Circles 12 S.W.G.	„		3	0¾
Plate as rolled	„		2	8
Sections	„		3	2
Wire 10 S.W.G.	„		2	11¼
Tubes 1 in. o.d. 16 S.W.G.	„		4	1

		£	s.	d.
Aluminium Alloys				
BS1470. HS10W.	lb.			
Sheet 10 S.W.G.	„		3	1
Sheet 18 S.W.G.	„		3	3½
Sheet 24 S.W.G.	„		3	11
Strip 10 S.W.G.	„		3	1
Strip 18 S.W.G.	„		3	2½
Strip 24 S.W.G.	„		3	10½
BS1477. HP30M.				
Plate as rolled	„		2	11
BS1470. HC15WP.				
Sheet 10 S.W.G.	„		3	9¼
Sheet 18 S.W.G.	„		4	2
Sheet 24 S.W.G.	„		5	0½
Strip 10 S.W.G.	„		3	10½
Strip 18 S.W.G.	„		4	2
Strip 24 S.W.G.	„		4	9¼
BS1477. HPC15WP.				
Plate heat treated	„		3	6¼
BS1475. HG10W.				
Wire 10 S.W.G.	„		3	10½
BS1471. HT10WP.				
Tubes 1 in. o.d. 16 S.W.G.	„		5	0½
BS1476. HE10WP.				
Sections	„		3	1½
Beryllium Copper				
Strip	„	1	4	11
Rod	„	1	1	6
Wire	„	1	4	9
Brass Tubes	„		1	11
Brazed Tubes	„		—	
Drawn Strip Sections	„		—	
Sheet	ton		—	
Strip	„	255	0	0
Extruded Bar	lb.		2	0¾
Extruded Bar (Pure Metal Basis)	„		—	
Condenser Plate (Yellow Metal)	ton	190	0	0
Condenser Plate (Naval Brass)	„	202	0	0
Wire	lb.		2	8¼
Copper Tubes	lb.		2	4¼
Sheet	ton	271	0	0
Strip	„	271	0	0
Plain Plates	„		—	
Locomotive Rods	„		—	
H.C. Wire	„	288	15	0
Cupro Nickel				
Tubes 70/30	lb.		3	7½
Lead Pipes (London)	ton	115	10	0
Sheets (London)	„	113	5	0
Tellurium Lead	„	£6 extra		
Nickel Silver				
Sheet and Strip 7%	lb.		3	9½
Wire 10%	„		4	4¼
Phosphor Bronze				
Wire	„		4	1¾

Titanium (1,000 lb. lots)			
Billet over 4″ dia.-18″ dia.	lb.	63/-	64/-
Rod 4″ dia.-·250″ dia.	„	75/-	112/-
Wire under ·250″ dia.-·036″ dia.	„	146/-	222/-
Sheet 8′ × 2′ × ·250″-·010″ thick	„	88/-	157/-
Strip ·048″-·003″ thick	„	100/-	350/-
Tube (representative gauge)	„		300/-
Extrusions	„		120/-

		£	s.	d.
Zinc Sheets, English destinations	ton	110	15	0
Strip	„	nom.		

Financial News

Metal Statistics

Detailed figures of the consumption and output of non-ferrous metals for the month of Sept., 1958, have been issued by the British Bureau of Non-Ferrous Metal Statistics, as follow in long tons:—

COPPER

	Gross Weight	Copper Content
Wire	30,757	30,397
Rods, bars and sections	11,386	7,707
Sheet, strips and plate	12,539	10,144
Tubes	7,261	6,726
Castings and miscellaneous	7,096	—
Sulphate	2,508	—
	71,547	61,408

Of which:

Consumption of Virgin Copper	52,018
Consumption of Copper and Alloy Scrap (Copper Content)	9,390

ZINC

Galvanizing	7,841
Brass	7,816
Rolled Zinc	2,185
Zinc Oxide	2,327
Zinc Die-casting alloy	4,494
Zinc Dust	1,127
Miscellaneous Uses	957
Total, All Trades	26,747

Of which:

High purity 99·99 per cent	4,799
Electrolytic and high grade 99·95 per cent	5,001
Prime Western, G.O.B. and debased	9,734
Remelted	493
Scrap Brass and other Cu alloys	2,574
Scrap Zinc, alloys and residues	2,961

ANTIMONY

Batteries	79
Other Antimonial Lead	40
Bearings	29
Oxides—for White Pigments	104
Oxides—other	76
Miscellaneous Uses	13
Sulphides	6
Total Consumption	347

Antimony in Scrap

For Antimonial Lead	364
For Other Uses	16
Total Consumption	380

LEAD

Cables	8,947
Batteries	2,262
Battery Oxides	1,845
Tetra Ethyl Lead	1,510
Other Oxides and Compounds	2,428
White Lead	865
Shot	396
Sheet and Pipe	8,515
Foil and Collapsible Tubes	433
Other Rolled and Extruded	484
Solder	1,168
Alloys	1,647
Miscellaneous Uses	1,029
Total	28,829

CADMIUM

Plating Anodes	42·55
Plating Salts	5·85
Alloys: Cadmium Copper	3·50
Alloys: Other	4·85
Batteries: Alkaline	5·50
Batteries: Dry	0·35
Solder	5·80
Colours	16·45
Miscellaneous Uses	1·45
Total Consumption	86·30

TIN

Tinplate	875
Tinning:	
Copper Wire	44
Steel Wire	8
All other	65
Solder	176
Alloys	492
Foil and Collapsible Tubes, etc.	45
Tin Compounds and Salts	68
Miscellaneous Uses	11
Total Consumption	1,784

Aluminium Rebate

It was confirmed by Aluminum Limited of Canada last week-end that consumers had been advised of the decision not to extend the two per cent loyalty rebate after the end of this year. The rebate was introduced in November, 1957, on sales to regular customers to meet the competition of increasing supplies of low-priced Soviet metal.

The Soviet Union has since agreed to limit exports to the United Kingdom to 15,000 tons a year, and the price is now fairly close to the Canadian level.

Birkett, Billington and Newton

Final dividend 10 per cent, making 12½ per cent year ended July 31, 1958 (interim 5 per cent, followed by 60 per cent scrip issue and final of 12½ per cent on increased capital). Trading profit, etc., £65,721 (£79,919) and net profit £19,476 (£21,430), after tax of £20,764 (£34,740).

Birmid Industries Ltd.

Group net profit £989,731 (£912,727). Distribution maintained at 17½ per cent. Trading profit £2,558,270 (£2,379,142). Fixed assets increased from £6,422,777 to £7,757,124. Current assets total £8,688,166 Current assets total £8,688,166 (£9,831,523). There are current liabilities of £3,045,330 (£3,484,015). Reserves aggregate £9,222,143 (£8,550,332).

Scrap Metal Prices

Merchants' average buying prices delivered, per ton, 18/11/58.

	£
Aluminium	
New Cuttings	140
Old Rolled	120
Segregated Turnings	90
Brass	
Cuttings	141
Rod Ends	139
Heavy Yellow	118
Light	113
Rolled	130
Collected Scrap	116
Turnings	131
Copper	
Wire	200
Firebox, cut up	196
Heavy	188
Light	183
Cuttings	200
Turnings	177
Braziery	155

	£
Gunmetal	
Gear Wheels	174
Admiralty	174
Commercial	159
Turnings	154
Lead	
Scrap	66
Nickel	
Cuttings	—
Anodes	500
Phosphor Bronze	
Scrap	159
Turnings	154
Zinc	
Remelted	58
Cuttings	45
Old Zinc	34

The latest available scrap prices quoted on foreign markets are as follow. (The figures in brackets give the English equivalents in £1 per ton):—

West Germany (D-marks per 100 kilos):

Used copper wire	(£195.17.6)	225
Heavy copper	(£191.10.0)	220
Light copper	(£161.0.0)	185
Heavy brass	(£119.2.6)	137
Light brass	(£91.7.6)	105
Soft lead scrap	(£61.0.0)	70
Zinc scrap	(£34.17.6)	40
Used aluminium unsorted	(£87.0.0)	100

France (francs per kilo):

Copper	(£213.2.6)	245
Heavy copper	(£213.2.6)	245
Light brass	(£143.10.0)	165
Zinc castings	(£61.0.0)	70
Lead	(£86.2.6)	99
Tin	—	
Aluminium	(£117.10.0)	135

Italy (lire per kilo):

Aluminium soft sheet clippings (new)	(£194.7.6)	335
Aluminium copper alloy	(£124.15.0)	215
Lead, soft, first quality	(£87.0.0)	150
Lead, battery plates	(£51.0.0)	88
Copper, first grade	(£220.10.0)	380
Copper, second grade	(£208.17.6)	360
Bronze, first quality machinery	(£214.12.6)	370
Bronze, commercial gunmetal	(£185.12.6)	320
Brass, heavy	(£153.15.0)	265
Brass, light	(£142.2.6)	245
Brass, bar turnings	(£148.0.0)	255
New zinc sheet clippings	(£58.0.0)	100
Old zinc	(£43.10.0)	75

THE STOCK EXCHANGE

Market Continued Irregular

ISSUED CAPITAL •	AMOUNT OF SHARE	NAME OF COMPANY	MIDDLE PRICE 18 NOVEMBER	+ RISE —FALL	DIV. FOR LAST FIN. YEAR	DIV. FOR PREV. YEAR	DIV. YIELD	1958 HIGH	1958 LOW	1957 HIGH	1957 LOW
£	£				Per cent	Per cent					
4,435,792	1	Amalgamated Metal Corporation ...	24/9	+1/-	9	10	7 5 6	24/9	17/6	28/3	18/-
400,000	2/-	Anti-Attrition Metal	1/7½		4	8½	4 18 6	1/7½	1/3	2/6	1/6
33,639,483	Stk. (£1)	Associated Electrical Industries ...	56/9	+1/-	15	15	5 5 9	56/9	46/6	72/3	47/9
1,590,000	1	Birfield	58/6	—6d.	15	15	5 2 6	62/4½	46/3	70/-	48/9
3,196,667	1	Birmid Industries	64/9xd	—2/9	17½	17½	5 8 3	77/-	55/3	80/6	55/9
5,630,344	Stk. (£1)	Birmingham Small Arms	35/-xd	+1/3	11	10	6 5 9	37/3	23/9	33/-	21/9
203,150	Stk. (£1)	Ditto Cum. A. Pref. 5%	15/-	—1/1½	5	5	6 13 3	16/1½	14/7½	16/-	15/-
350,580	Stk. (£1)	Ditto Cum. B. Pref. 6%	17/1½		6	6	7 0 3	17/4½	16/6	19/-	16/6
500,000	1	Bolton (Thos.) & Sons	26/3		10	12½	7 12 6	28/9	24/-	30/3	28/9
300,000	1	Ditto Pref. 5%	15/-		5	5	6 13 3	16/-	15/-	16/9	14/3
160,000	1	Booth (James) & Co. Cum. Pref. 7%	20/4½		7	7	6 18 3	20/4½	19/-	22/3	18/9
9,000,000	Stk. (£1)	British Aluminium Co.	60/9	+2/-	12	12	3 19 0	60/9	36/6	72/-	38/3
1,500,000	Stk. (£1)	Ditto Pref. 6%	19/6		6	6	6 3 0	20/-	18/4½	21/6	18/-
15,000,000	Stk. (£1)	British Insulated Callender's Cables	50/9	—3d.	12½	12½	4 18 6	51/-	38/9	55/-	40/-
17,047,166	Stk. (£1)	British Oxygen Co. Ltd., Ord. ...	45/-	—1/-	10	10	4 9 0	46/-	29/-	39/-	29/6
600,000	Stk. (5/-)	Canning (W.) & Co.	24/3	+6d.	25+ *2½C	25	5 3 0	24/6	19/7½	24/6	19/3
60,484	1/-	Carr (Chas.)	1/6	—1½d.	25	25	11 13 3	2/3	1/4½	3/6	2/1½
150,000	2/-	Case (Alfred) & Co. Ltd.	4/10½		25	25	10 5 0	5/3	4/-	4/6	4/-
555,000	1	Clifford (Chas.) Ltd.	21/-		10	10	9 10 6	21/-	16/-	20/6	15/9
45,000	1	Ditto Cum. Pref. 6%	15/6		6	6	7 14 9	16/-	15/-	17/6	16/-
250,000	2/-	Coley Metals	3/-		20	25	13 6 9	4/6	2/6	5/7½	3/9
8,730,596	1	Cons. Zinc Corp.†	56/6	—1/6	18¾	22½	6 19 9	58/-	41/-	92/6	49/-
1,136,233	1	Davy & United	75/-	—3d.	20	15	5 6 9	75/6	45/9	60/6	42/6
2,750,000	5/-	Delta Metal	24/10½	+10½d.	30	*17½	6 0 6	24/10½	17/7½	28/6	19/-
4,160,000	Stk. (£1)	Enfield Rolling Mills Ltd.	38/-	+1/6	12½	15B	6 11 6	38/-	22/9	38/6	25/-
750,000	1	Evered & Co.	28/-		15Z	15	7 2 9	28/3	26/-	52/9	42/-
18,000,000	Stk. (£1)	General Electric Co.	35/9	—1/6	10	12½	5 12 0	39/6	29/6	59/-	38/-
1,500,000	Stk. (10/-)	General Refractories Ltd.	35/9	—6d.	20	17½	5 12 0	37/6	27/3	37/-	26/9
401,240	1	Gibbons (Dudley) Ltd.	65/4½		15	15	4 11 6	67/-	61/-	71/-	53/-
750,000	5/-	Glacier Metal Co. Ltd.	7/-	—1½d.	11½	11½	8 4 3	7/9	5/6	8/1½	5/10½
1,750,000	5/-	Glynwed Tubes	16/7½	—9d.	20	20	6 0 3	18/1½	12/10½	18/-	12/6
5,421,049	10/-	Goodlass Wall & Lead Industries ...	28/3	+9d.	13‖	18Z	4 12 0	28/3	19/3	37/3	28/9
342,195	1	Greenwood & Batley	52/6	—1/6	20	17½	7 12 6	54/-	45/-	50/-	46/-
396,000	5/-	Harrison (B'ham) Ord.	15/9	+3d.	*15	*15	4 15 3	15/9	11/6	16/9	12/4½
150,000	1	Ditto Cum. Pref. 7%	19/9		7	7	7 1 9	19/9	18/4½	22/3	18/7½
1,075,167	5/-	Heenan Group	8/3xd		10	10‡	6 1 3	9/7½	6/9	10/4½	6/9
236,953,260	Stk. (£1)	Imperial Chemical Industries ...	35/9		12Z	10	4 9 6	35/9	27/7½	46/6	36/3
33,708,769	Stk. (£1)	Ditto Cum. Pref. 5%	16/9		5	5	5 19 6	17/1½	16/-	18/6	15/6
14,584,025	**	International Nickel	160	—½	$3.75	$3.75	4 3 6	168½	132¾	222	130
430,000	5/-	Jenks (E. P.), Ltd.	8/9		27½ϕ	27½	7 17 3	8/10½	6/7½	18/10½	15/1½
300,000	1	Johnson, Matthey & Co. Cum. Pref. 5%	16/3		5	5	6 3 0	16/9	15/-	17/-	14/6
3,987,435	1	Ditto Ord.	45/-	+1/3	10	10	4 9 0	45/3	36/6	58/9	40/-
600,000	10/-	Keith, Blackman	27/6	+2/6	17½	15	6 7 3	27/6	15/-	21/9	15/-
160,000	4/-	London Aluminium	5/-		10	10	8 0 0	5/-	3/-	6/9	3/6
2,400,000	1	London Elec. Wire & Smith's Ord. ...	64/-		12½	12½	3 18 0	64/-	39/9	54/6	41/-
400,000	1	Ditto Pref.	23/10½		7½	7½	6 5 9	23/10½	22/3	25/3	21/9
765,012	1	McKechnie Brothers Ord.	42/6xd	—3d.	15	15	7 1 3	44/-	32/-	48/9	37/6
1,530,024	1	Ditto A Ord.	42/6xd	—6d.	15	15	7 1 3	45/-	30/-	47/6	36/-
1,108,268	5/-	Manganese Bronze & Brass	13/6	—3d.	20	27½‡	7 8 3	13/9	8/9	21/10½	7/6
50,628	6/-	Ditto (7½% N.C. Pref.)	6/-		7½	7½	7 10 0	6/3	5/9	6/6	5/-
13,098,855	Stk. (£1)	Metal Box	63/-	—4½d.	11	11	3 9 9	63/4½	41/9	59/-	40/3
415,760	Stk. (2/-)	Metal Traders	8/9	+1½d.	50	50	11 8 6	8/9	6/3	8/-	6/3
160,000	1	Mint (The) Birmingham	20/-		10	10	10 0 0	22/9	19/-	25/-	21/6
80,000	5	Ditto Pref. 6%	70/6		6	6	8 10 3	83/6	70/6	90/6	83/6
3,705,670	Stk. (£1)	Morgan Crucible A	42/3	+9d.	10	10	4 14 9	42/3	34/-	54/-	35/-
1,000,000	Stk. (£1)	Ditto 5½% Cum. 1st Pref. ...	17/7½		5½	5½	6 4 6	17/9	17/-	19/3	16/-
2,200,000	Stk (£1)	Murex	52/9	—6d.	17½	20	6 12 9	58/9	47/9	79/9	57/-
468,000	5/-	Ratcliffs (Great Bridge)	10/6		10	10	4 5 3	11/1½	6/10½	8/-	6/10½
234,960	10/-	Sanderson Bros. & Newbould ...	25/6xd	+1/-	20	27½D	7 16 9	27/-	24/6	41/-	24/9
1,365,000	Stk. (5/-)	Serck	17/4½	+3d.	15	17½	4 6 3	17/4½	11/-	18/10½	11/6
6,698,586	Stk. (£1)	Stone-Platt Industries	43/9xd	+6d.	15	12½	6 17 0	43/9	22/6	33/4½	22/7½
2,928,963	Stk. (£1)	Ditto 5½% Cum. Pref.	16/-		5½	5½	6 17 6	16/-	12/7½	14/-	12/9
14,494,862	Stk. (£1)	Tube Investments Ord.	76/6	+2/3	17½	15	4 11 6	76/6	48/4½	70/9	50/6
41,000,000	Stk. (£1)	Vickers	35/-	+1/3	10	10	5 14 3	35/-	28/9	46/-	29/-
750,000	Stk. (£1)	Ditto Pref. 5%	15/6		5	5	6 9 0	15/6	14/3	18/-	14/-
6,863,807	Stk. (£1)	Ditto Pref. 5% tax free	22/-		*5	*5	7 0 3A	23/-	21/3	24/9	20/7½
2,200,000	1	Ward (Thos. W.), Ord.	80/6	+2/-	20	15	4 19 3	87/-	70/9	83/-	64/-
2,666,034	Stk. (£1)	Westinghouse Brake	43/-		10	18P	4 15 9	43/-	32/6	85/-	29/1½
225,000	2/-	Wolverhampton Die-Casting ...	10/-	+3d.	30	25	6 0 0	10/1½	7/-	10/1½	7/-
591,000	5/-	Wolverhampton Metal	20/9	+9d.	27½	27½	6 17 3	22/9	14/9	22/3	14/9
78,465	2/6	Wright, Bindley & Gell	4/6		20	17½E	11 2 3	4/10½	2/9	3/9	2/7½
124,140	1	Ditto Cum. Pref. 6%	13/-		6	6	9 4 6	13/-	11/3	12/6	11/3
150,000	1/-	Zinc Alloy Rust Proof	2/9		27	40D	9 16 3	3/1½	2/7½	5/-	2/9

*Dividend paid free of Income Tax. †Incorporating Zinc Corpn. & Imperial Smelting. **Shares of no Par Value. ‡ and 100% Capitalized issue. • The figures given relate to the issue quoted in the third column. A Calculated on £7 14 6 gross. Y Calculated on 11½% dividend. ‖Adjusted to allow for capitalization issue. E for 15 months. P and 100% capitalized issue, also "rights" issue of 2 new shares at 35/- per share for £3 stock held. D and 50% capitalized issue. Z and 50% capitalized issue. B equivalent to 12½% on existing Ordinary Capital after 100% capitalized issue. ϕ And 100% capitalized issue. X Calculated on 17½%. C Paid out of Capital Profits.